
Intel
Developer
Forum
Spring 2002
intel

Expanding Moore's Law

Patrick P. Gelsinger
Vice President & CTO

February 28, 2002

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Intel Developer Forum Spring 2002

Today's Agenda

- Extending Moore's Law
- Expanding Moore's Law
- High Potential Technologies
- New Computing and Communications Geography

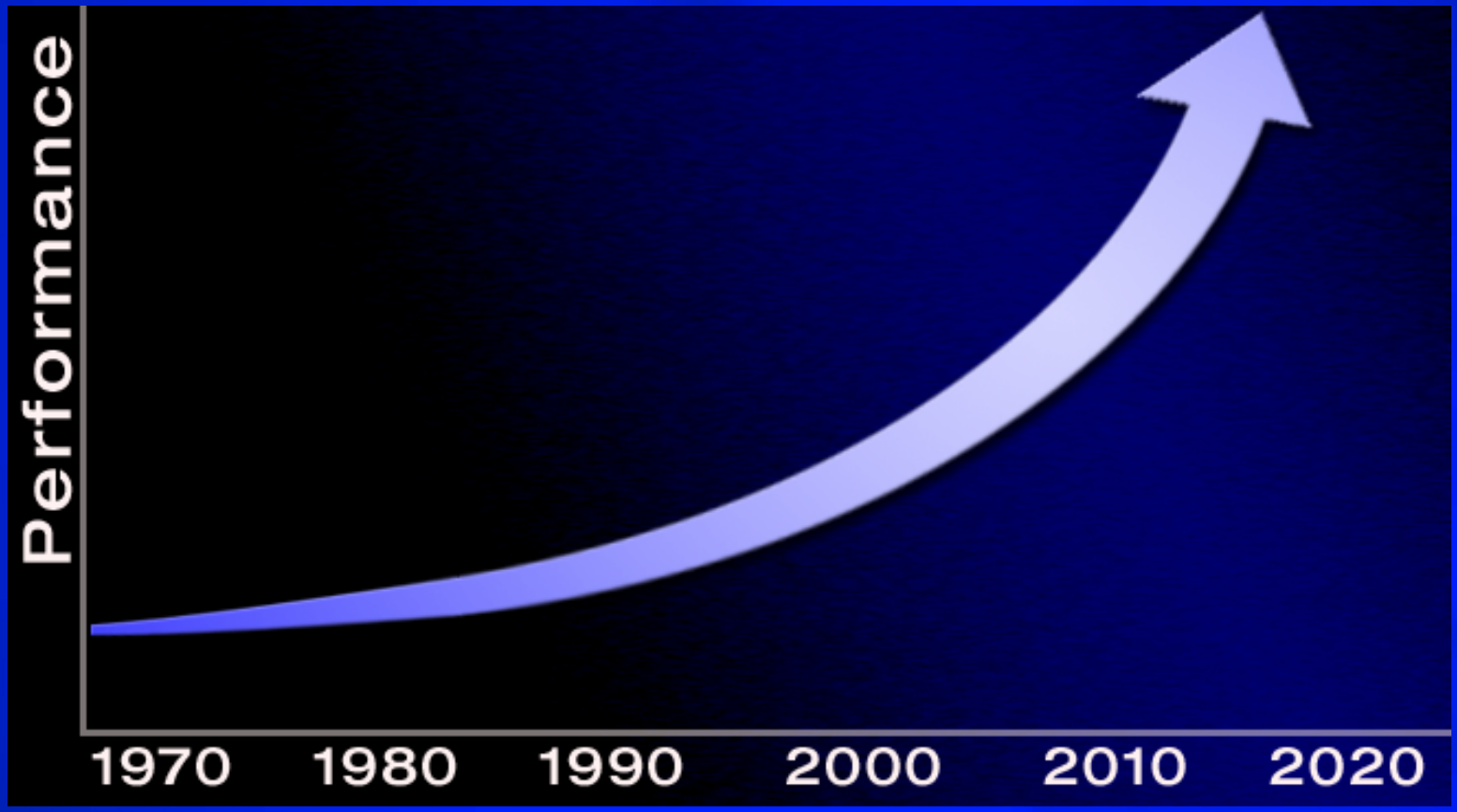
Extending Moore's Law

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Moore's Law:

The Accelerating Power Curve of Exponential Growth



“To God there is no zero.”

Richard Matheson
The Incredible Shrinking Man

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Intel Does Moore's Law Best



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Intel Does Moore's Law Best



Delivering More MHz and More MIPS

Intel Does Moore's Law Best



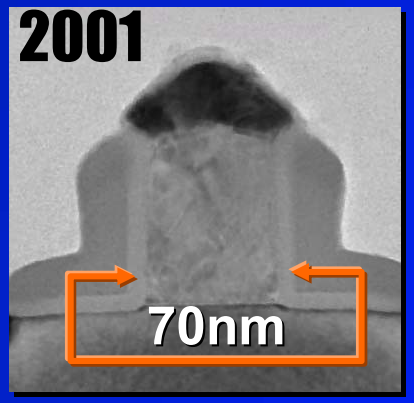
Delivering More MHz and More MIPS

Technologies to Keep on Delivering

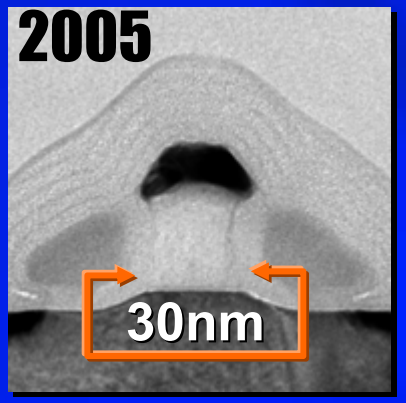
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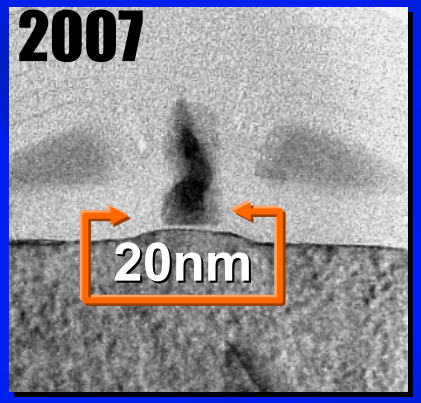
Transistor Leadership Continues



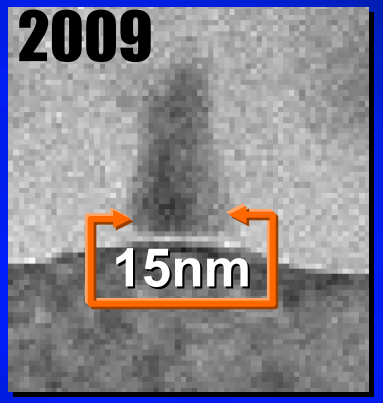
0.13µm process



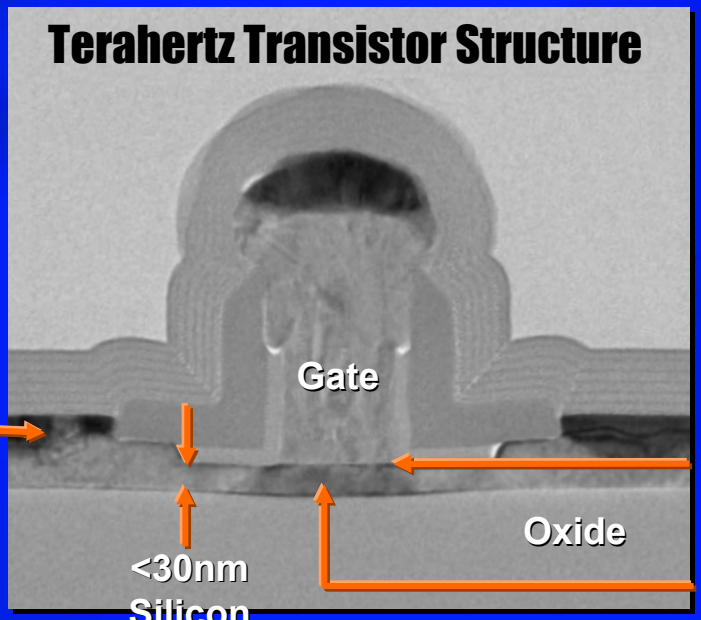
65nm process



45nm process



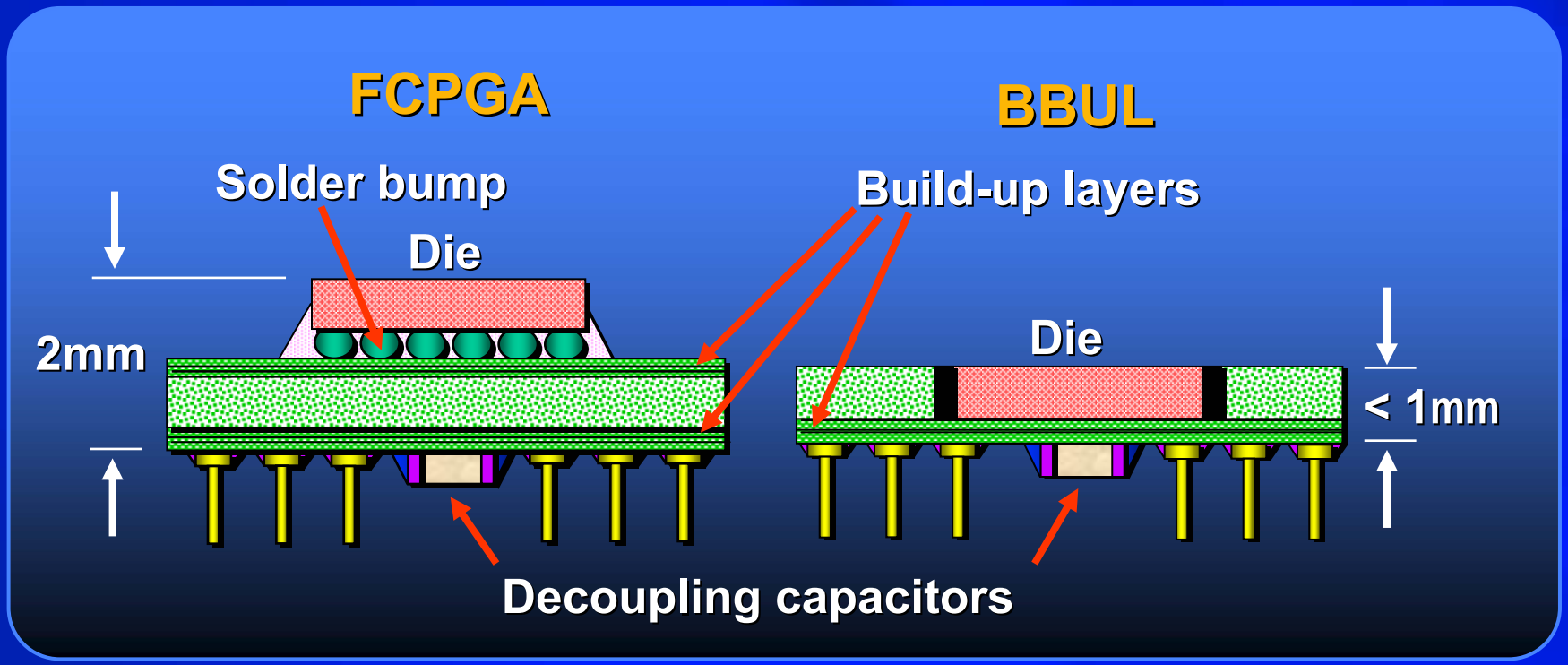
32nm process



Source: Intel

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Packaging Innovations: BBUL Bumpless Build-Up Layer



Extreme Ultraviolet Lithography (EUVL)



- Industry consortium for next-generation lithography
 - 1/20th wavelength
- 10-year effort
- Production in second half of decade

Industry First Reflective Mask for EUVL in 2001

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Intel Does Moore's Law Best



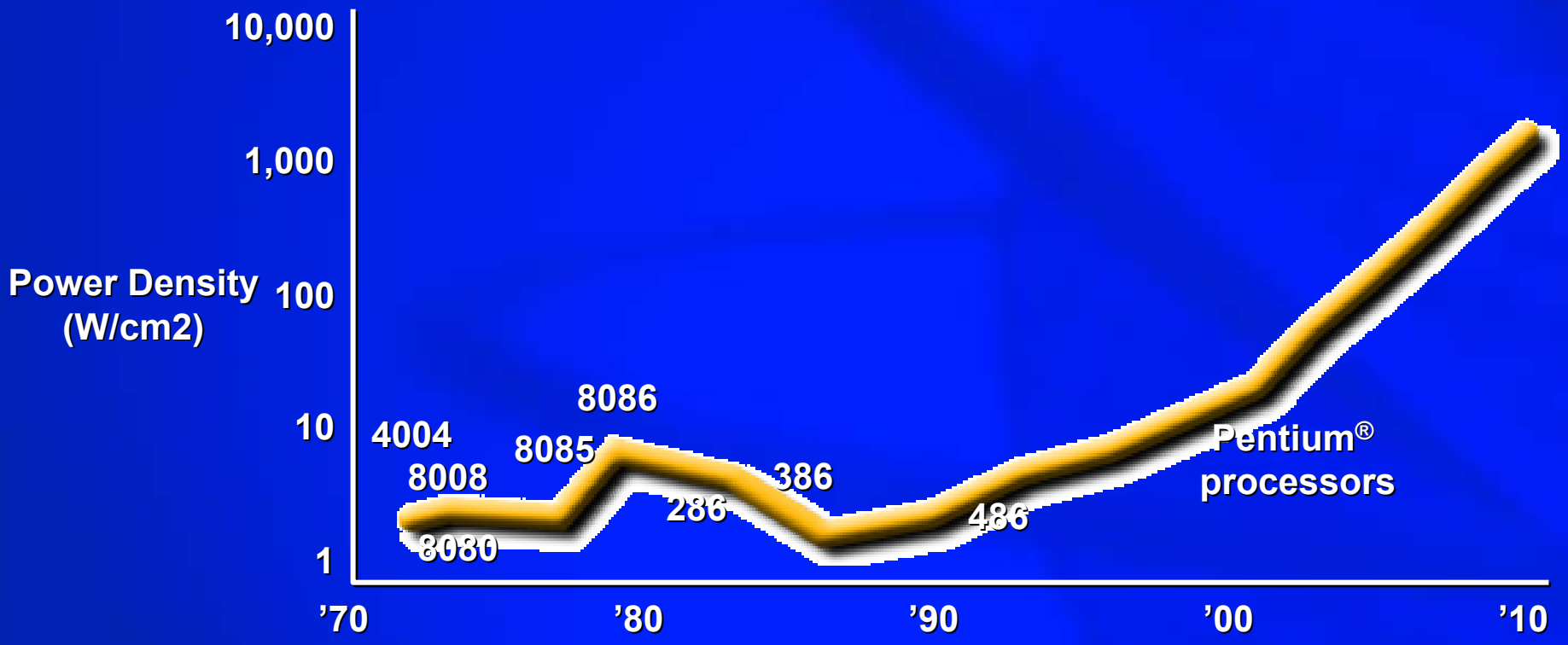
Delivering More MHz and More MIPS

Technologies to Keep on Delivering

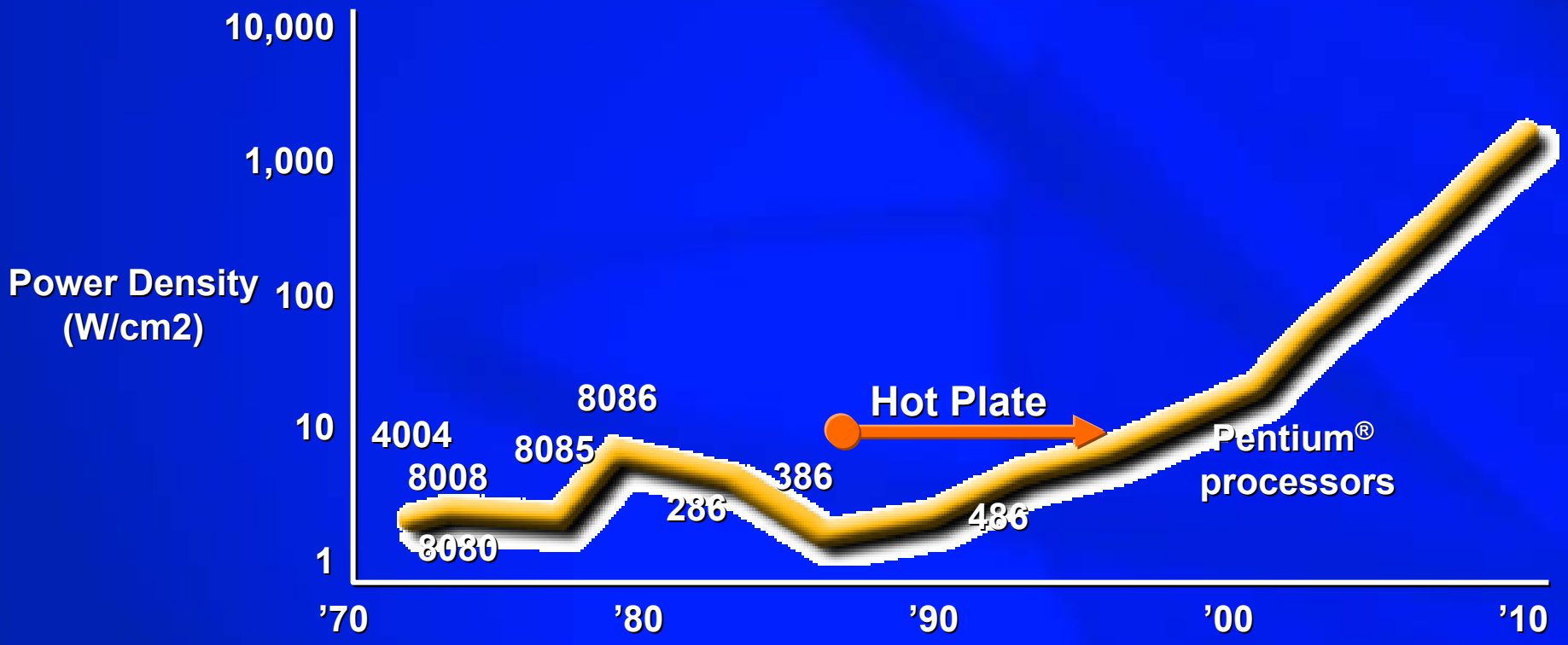
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Power Density

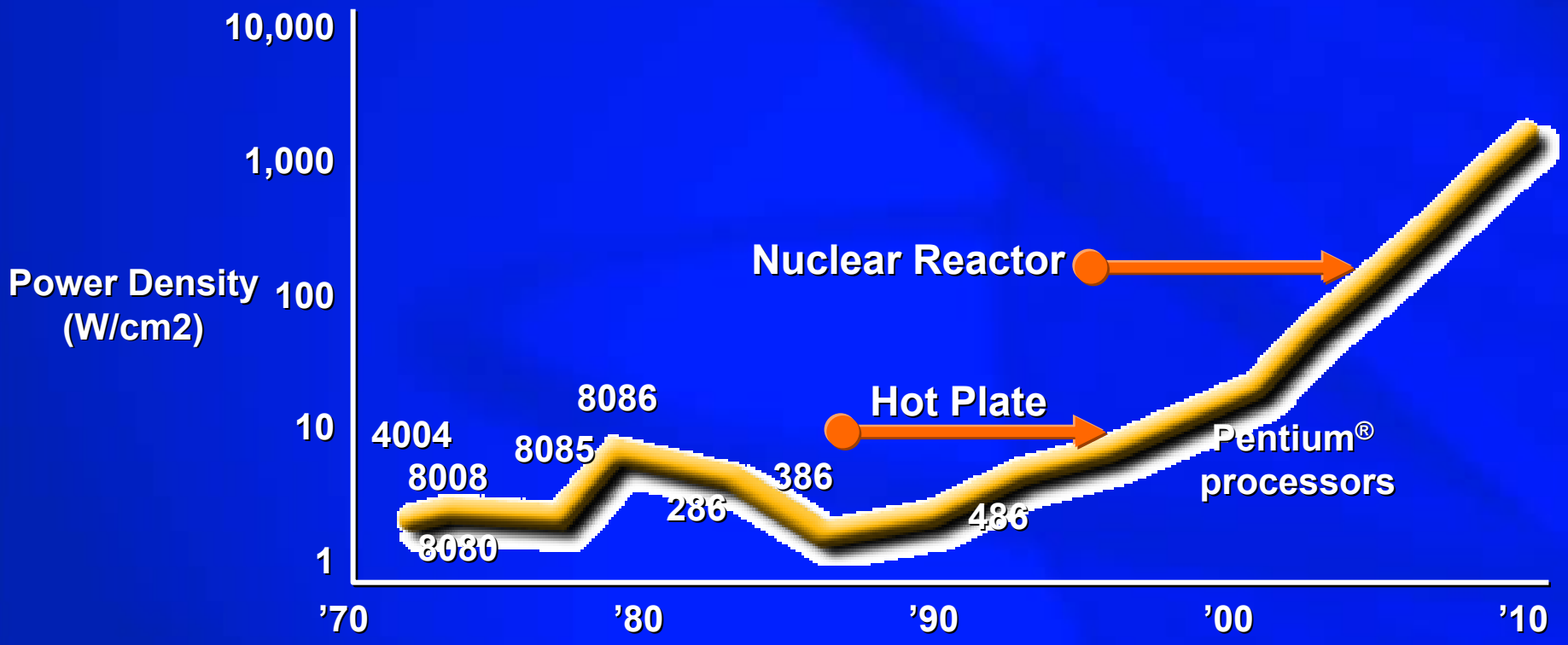


Power Density

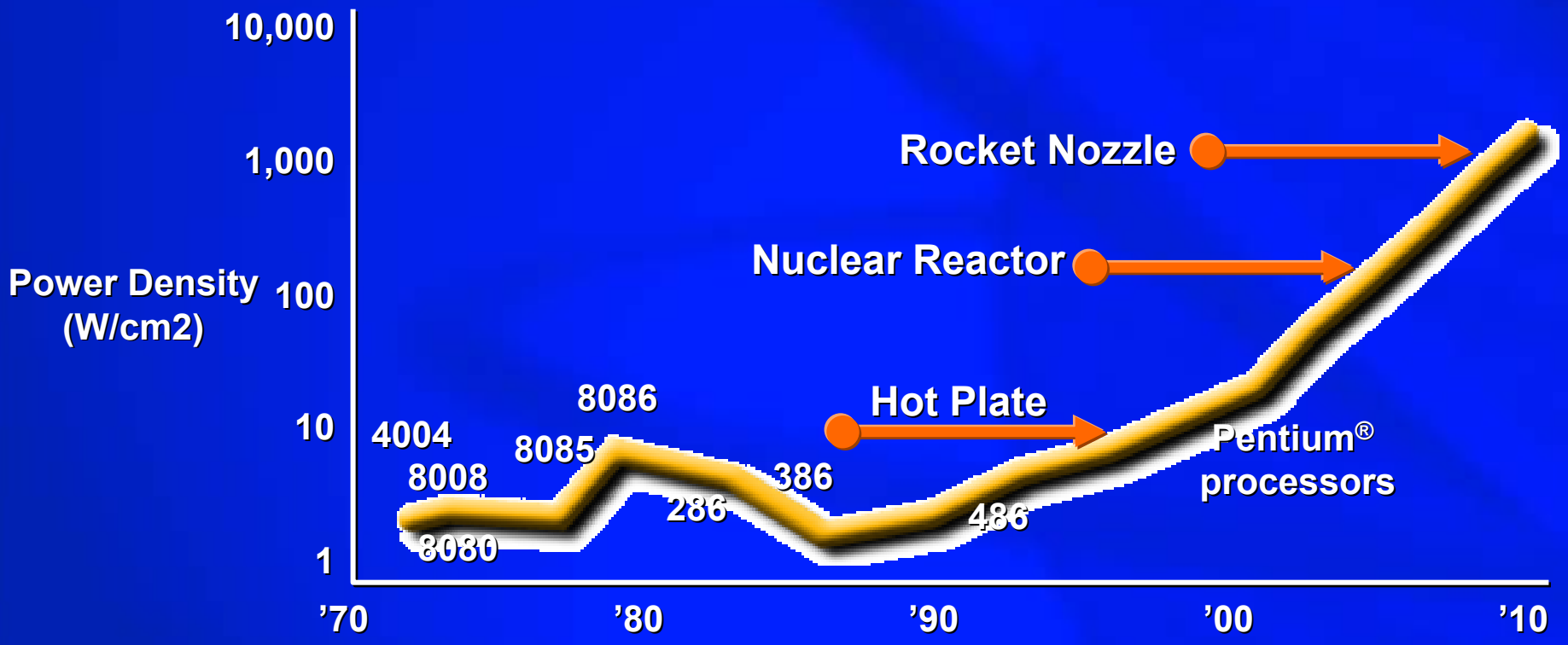


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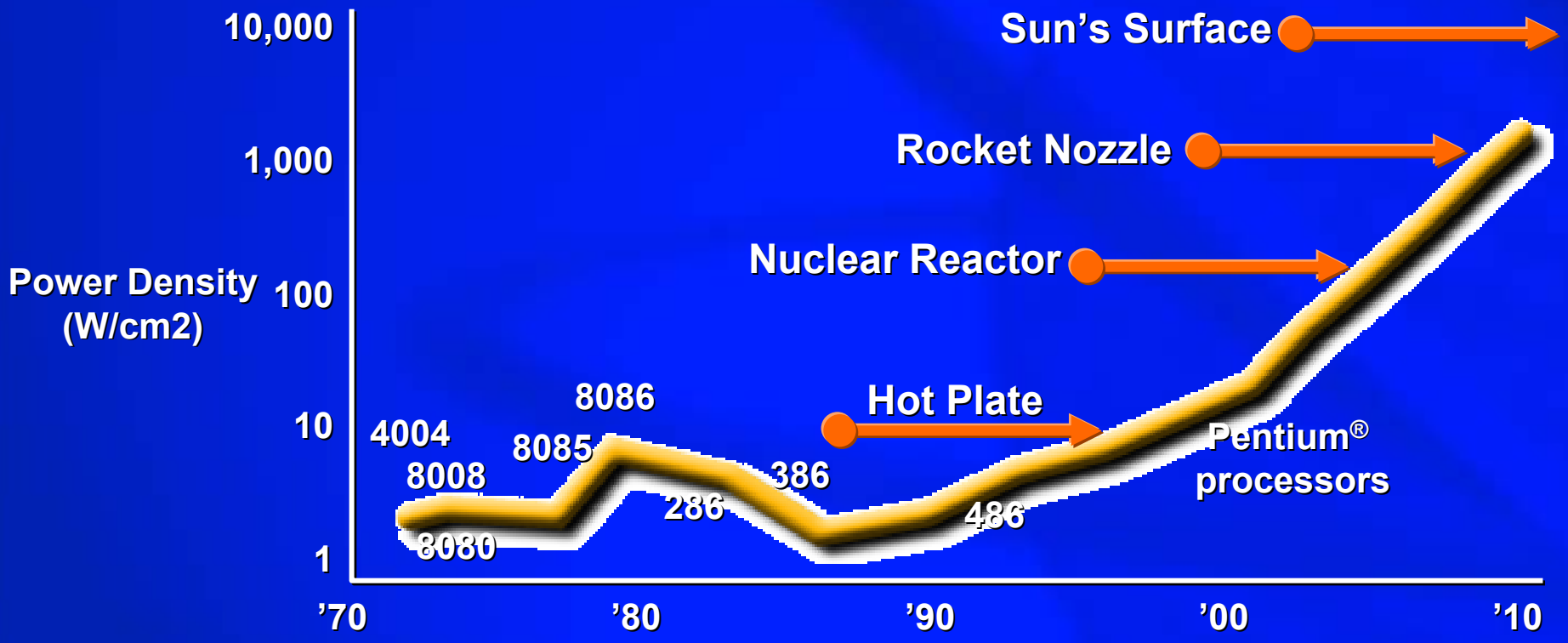
Power Density



Power Density



Power Density



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Addressing Power

c|net

02/06/02 – Intel "hyperthreading" to debut soon

EETIMES

11/27/01 – Intel boosts switching speeds "beyond 1THz" with 15nm gate

Business Wire

02/12/02 – Intel Advances Power and Performance for Wireless Devices

Bloomberg.com

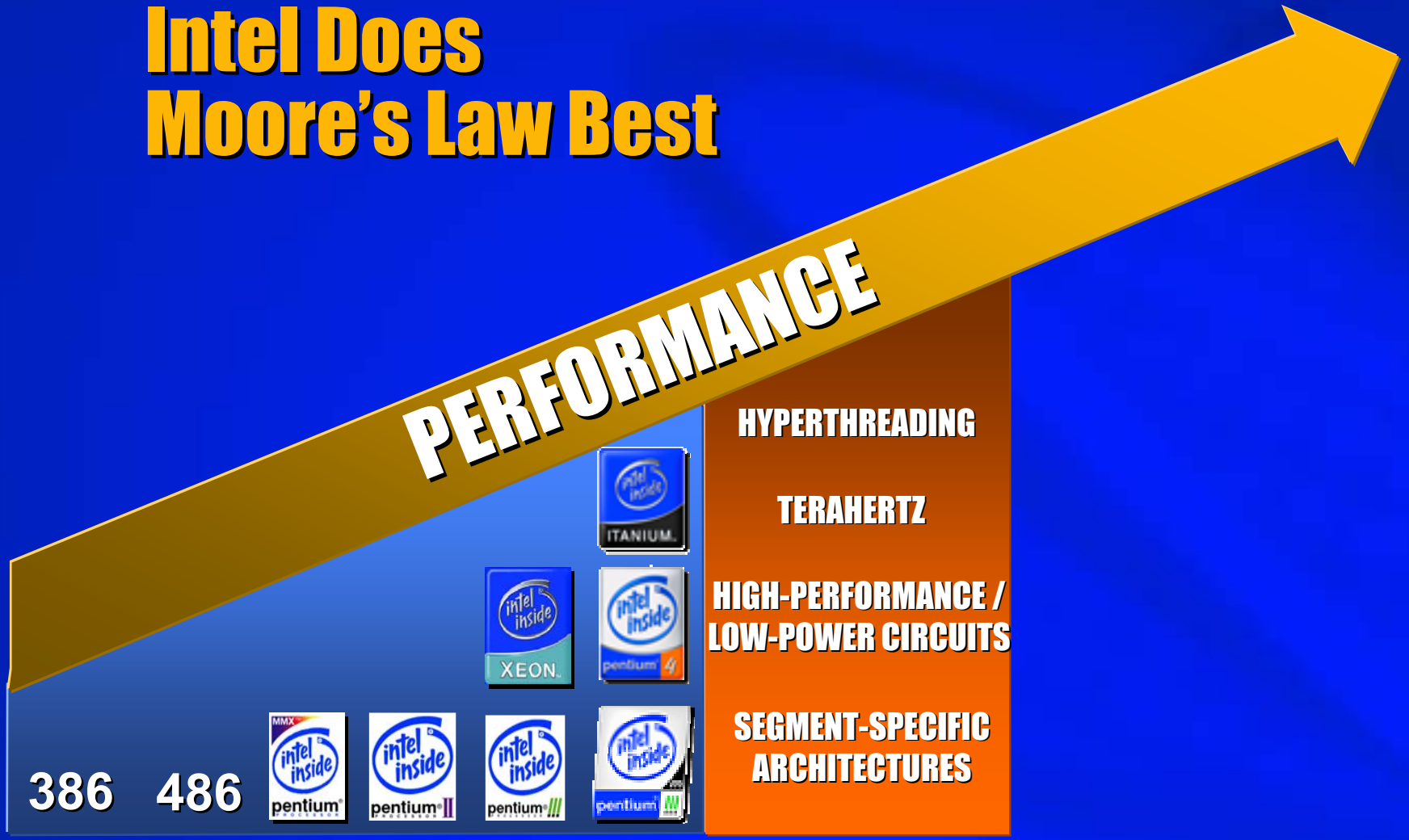
11/26/01 – Intel Researchers Design Tiny Transistors to Reduce Power Needs

EETIMES

02/04/02 – Latest Intel Processor Could Steal the ISSCC Show

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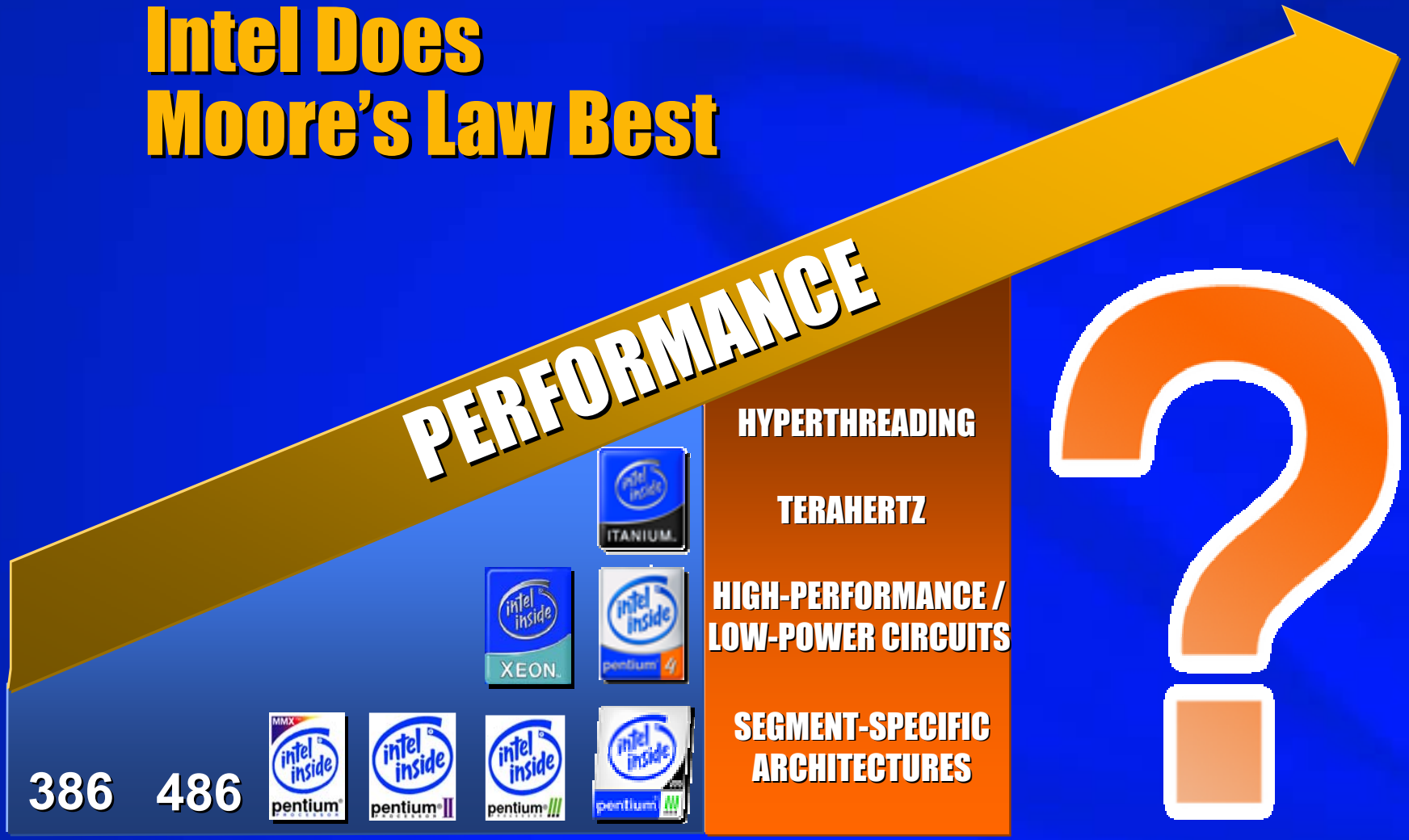


Delivering More MHz and More MIPS

Technologies to Keep on Delivering

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Intel Does Moore's Law Best



Delivering More MHz and More MIPS

Technologies to Keep on Delivering

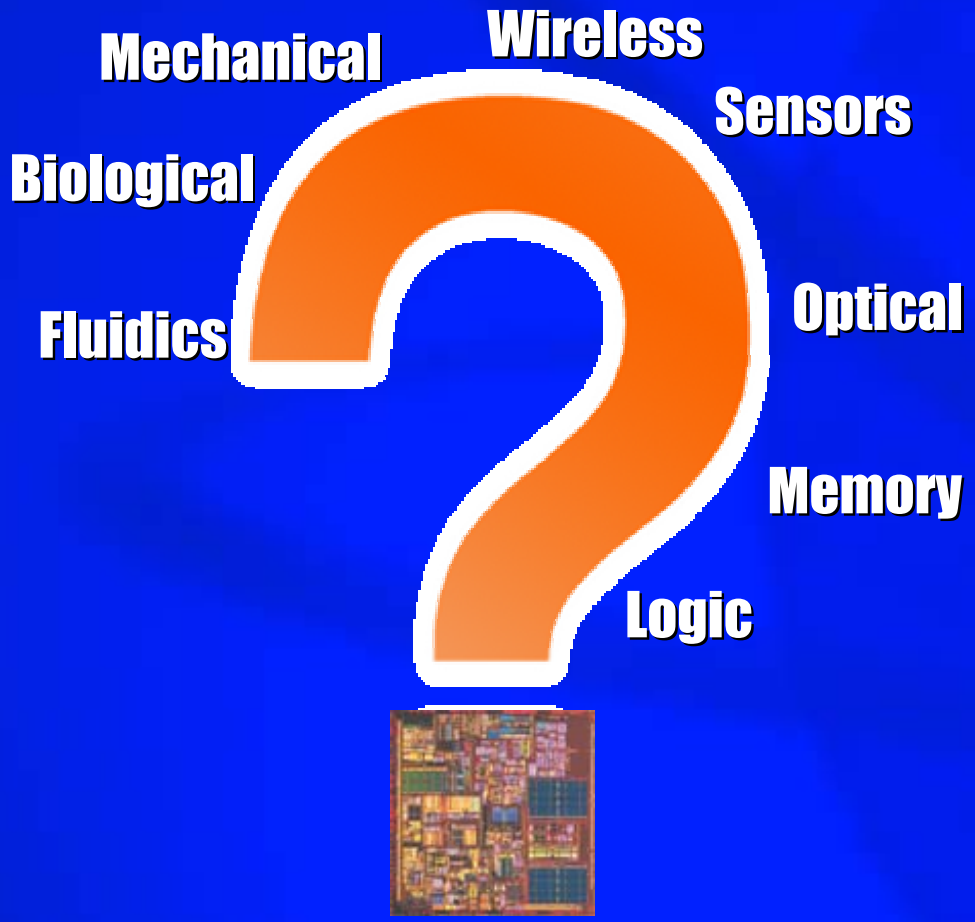
Expanding Beyond Performance

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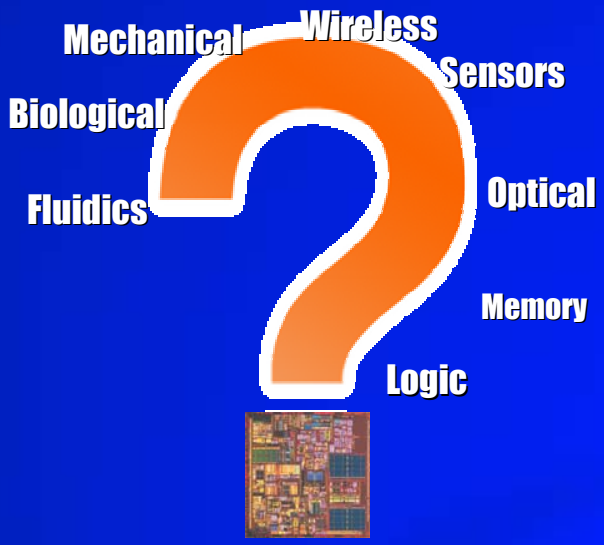
Moore's Law is Expanding

...what does that mean?

Expanding Moore's Law

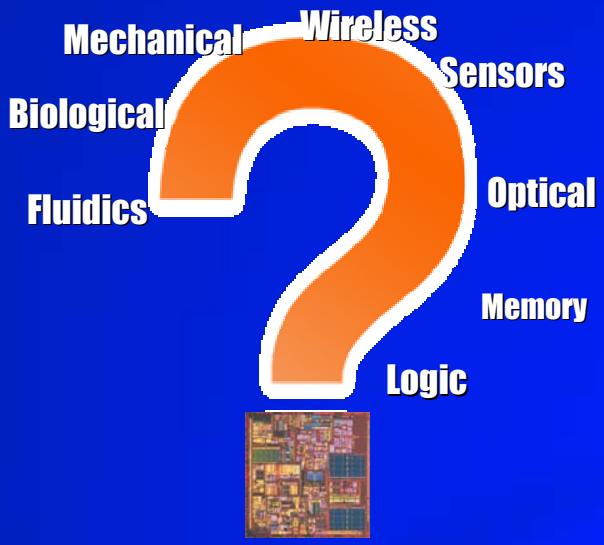


Expanding Moore's Law



PERFORMANCE	NEW FUNCTIONALITY
NICHE	UBIQUITOUS
TRADITIONAL USES	NEW MARKETS

Expanding Moore's Law



Wireless

Sensors

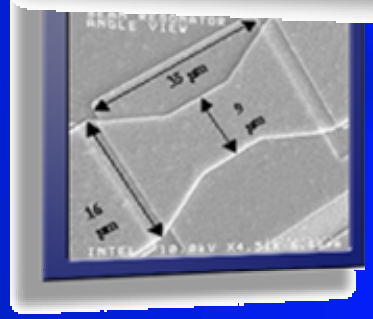
Optical

“Radio Free Intel”

“Radio Free Intel”

“Radio Free Intel”

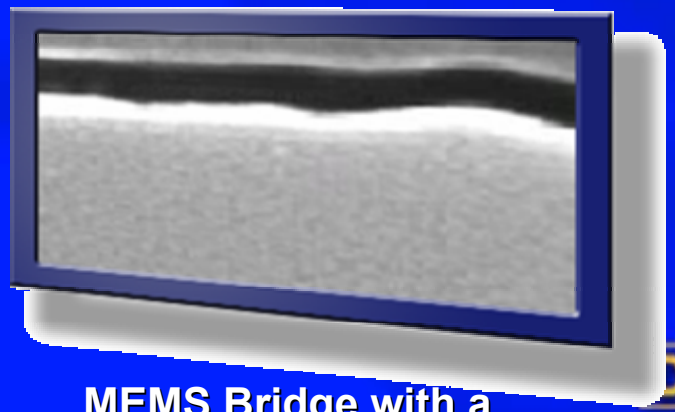
Micro-Electro Mechanical System (MEMS)



MEMS Bridge



MEMS Cantilever



MEMS Bridge with a 0.014µm Air Gap

“Radio Free Intel”

Intelligent Roaming







“Radio Free Intel”

MEMS

Intelligent Roaming

Silicon Radio

Dynamically Reconfigurable

Demo

Silicon Radio



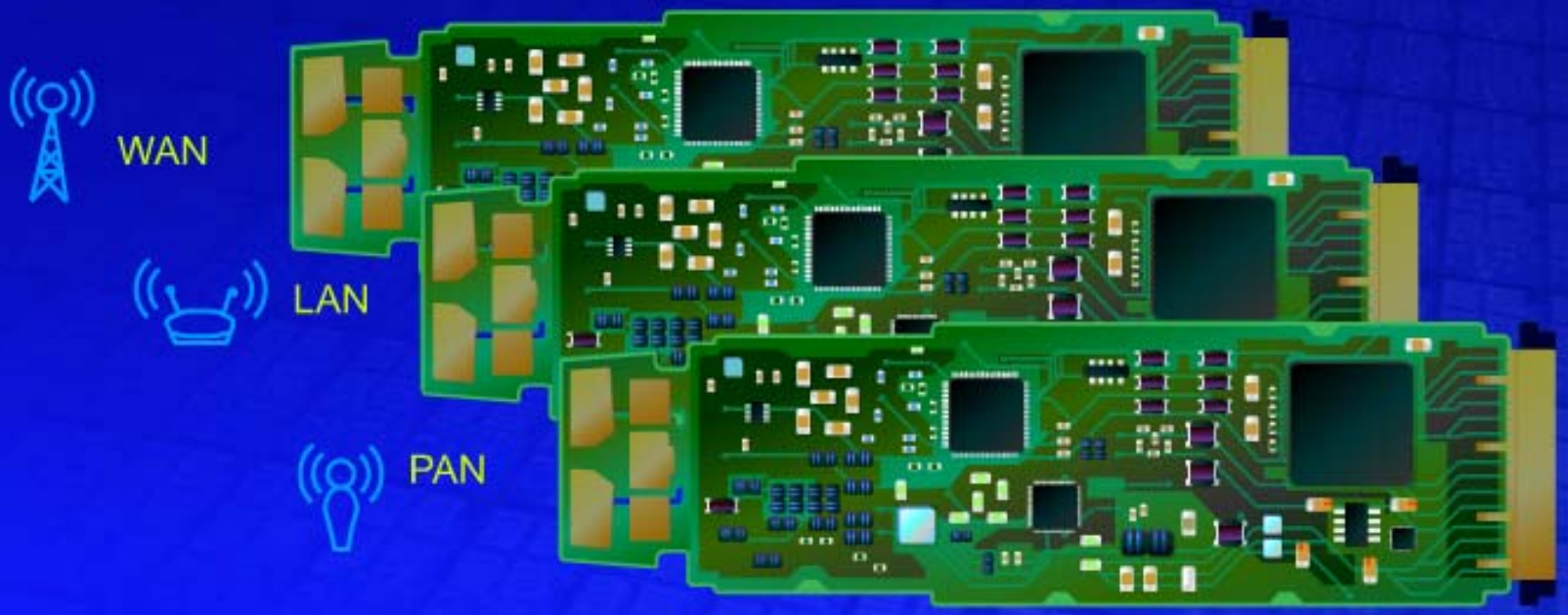
Today



100s of Millions

Cost
Power
Size

Silicon Radio



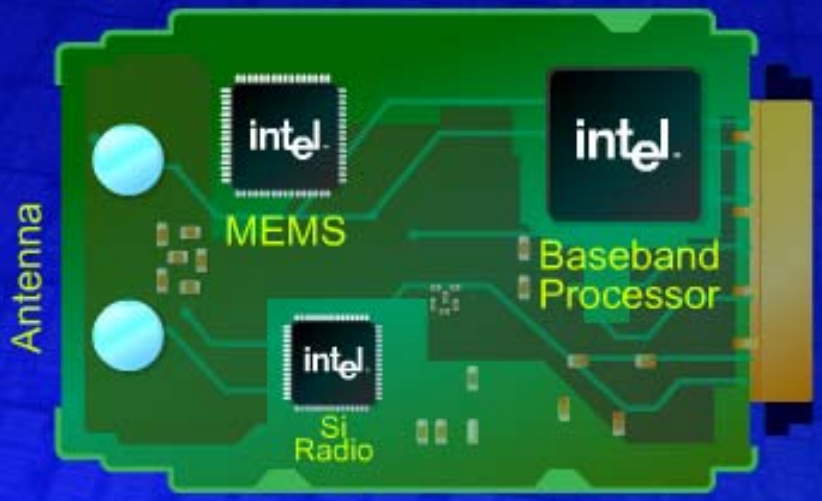
Today



100s of Millions

Cost
Power
Size

Silicon Radio



Today



100s of Millions

Cost
Power
Size

Tomorrow



Billions

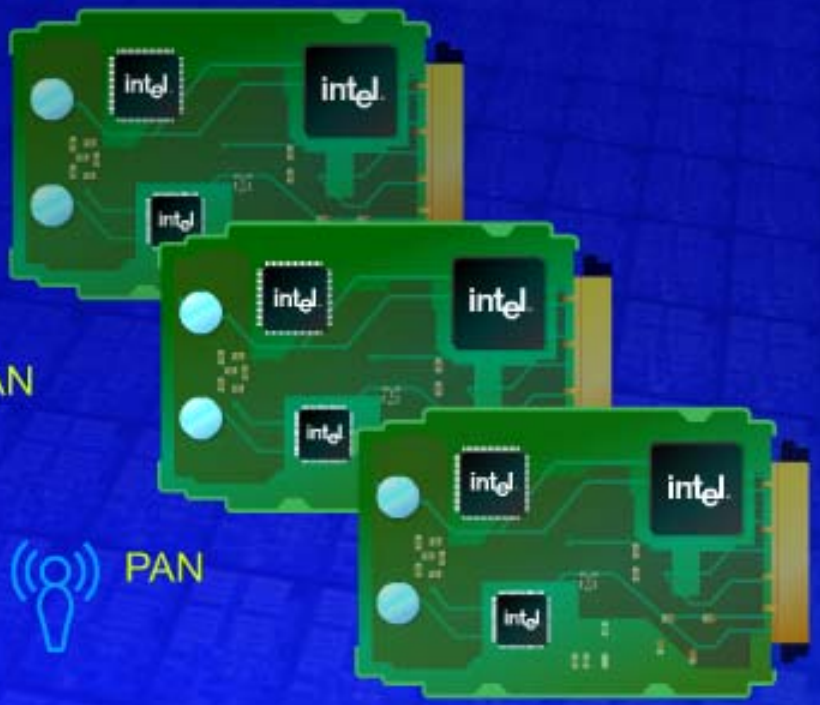
Cost
Power
Size

Silicon Radio

WAN

LAN

PAN



Today



100s of Millions

Cost
Power
Size

Tomorrow



Billions

Cost
Power
Size

Silicon Radio



Today



100s of Millions

Cost
Power
Size

Tomorrow



Billions

Cost
Power
Size

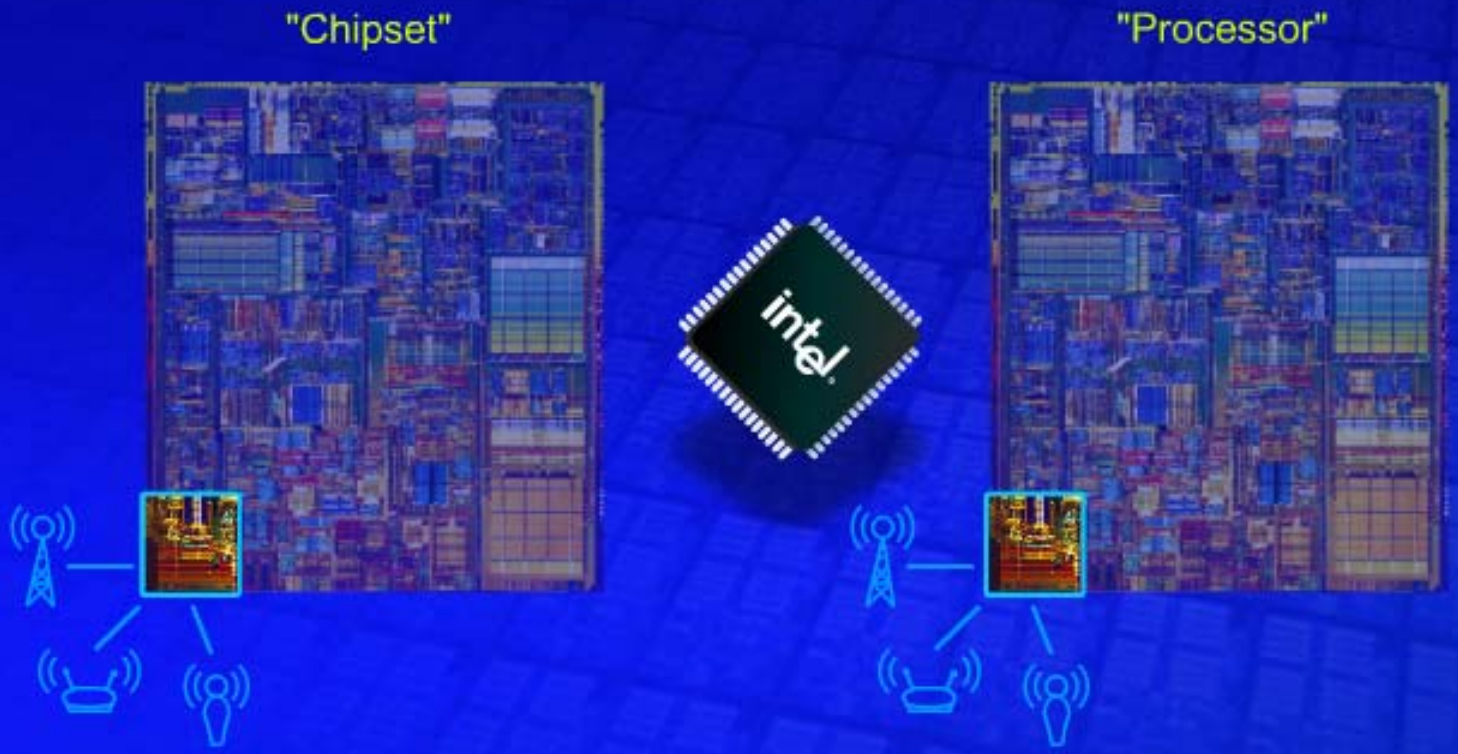
Future



10s of Billions

Cost
Power
Size

Silicon Radio



the Vision

Next Opportunity: Ultra-Wideband

CommWeb

02/15/02 – FCC Authorizes Ultra-Wideband Devices

Aerospace Daily

02/15/02 – FCC allocates spectrum for ultra-wideband use

When Radio Becomes "Free"

- Fully integrated
- Always connected
- Multiple networks



the Vision

Dr. David Culler



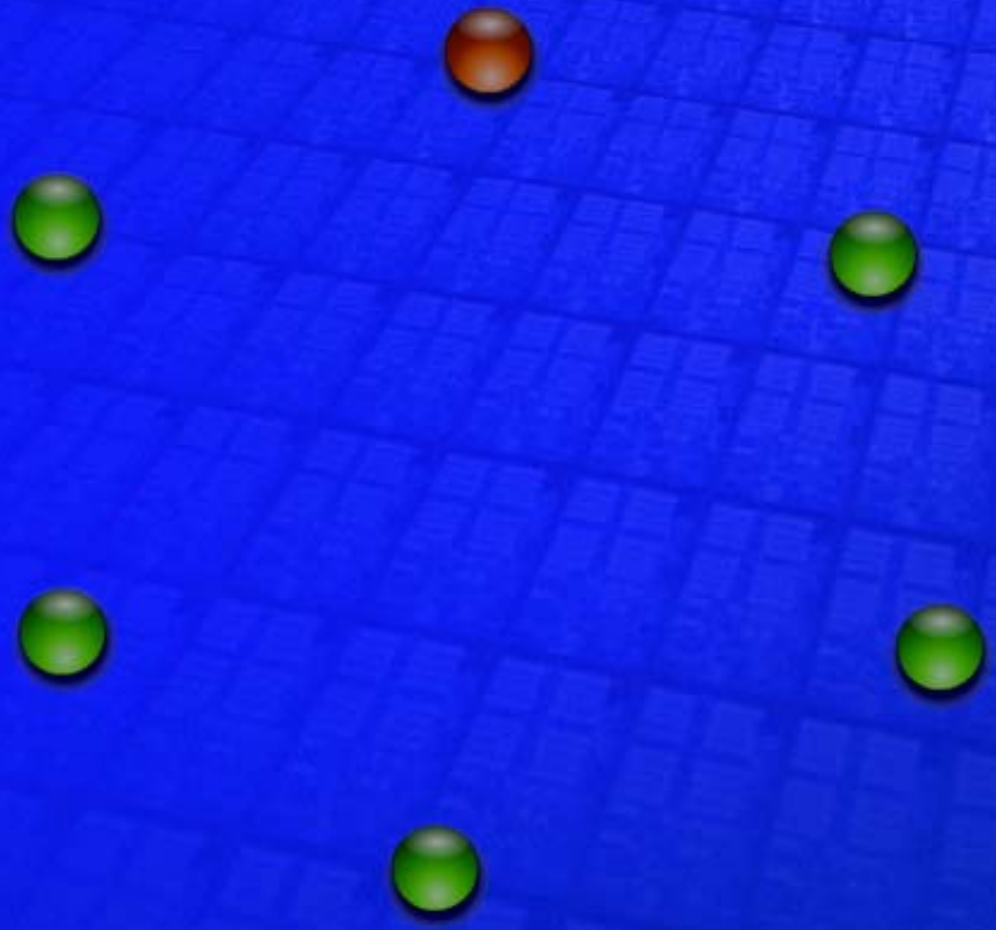
Dr. David Culler

- Director, Intel Research Lab, University of California at Berkeley
- NSF Presidential Faculty Fellow
- Research focuses on extremely networked systems – very large, very small, very numerous



Ad-hoc Sensor Network

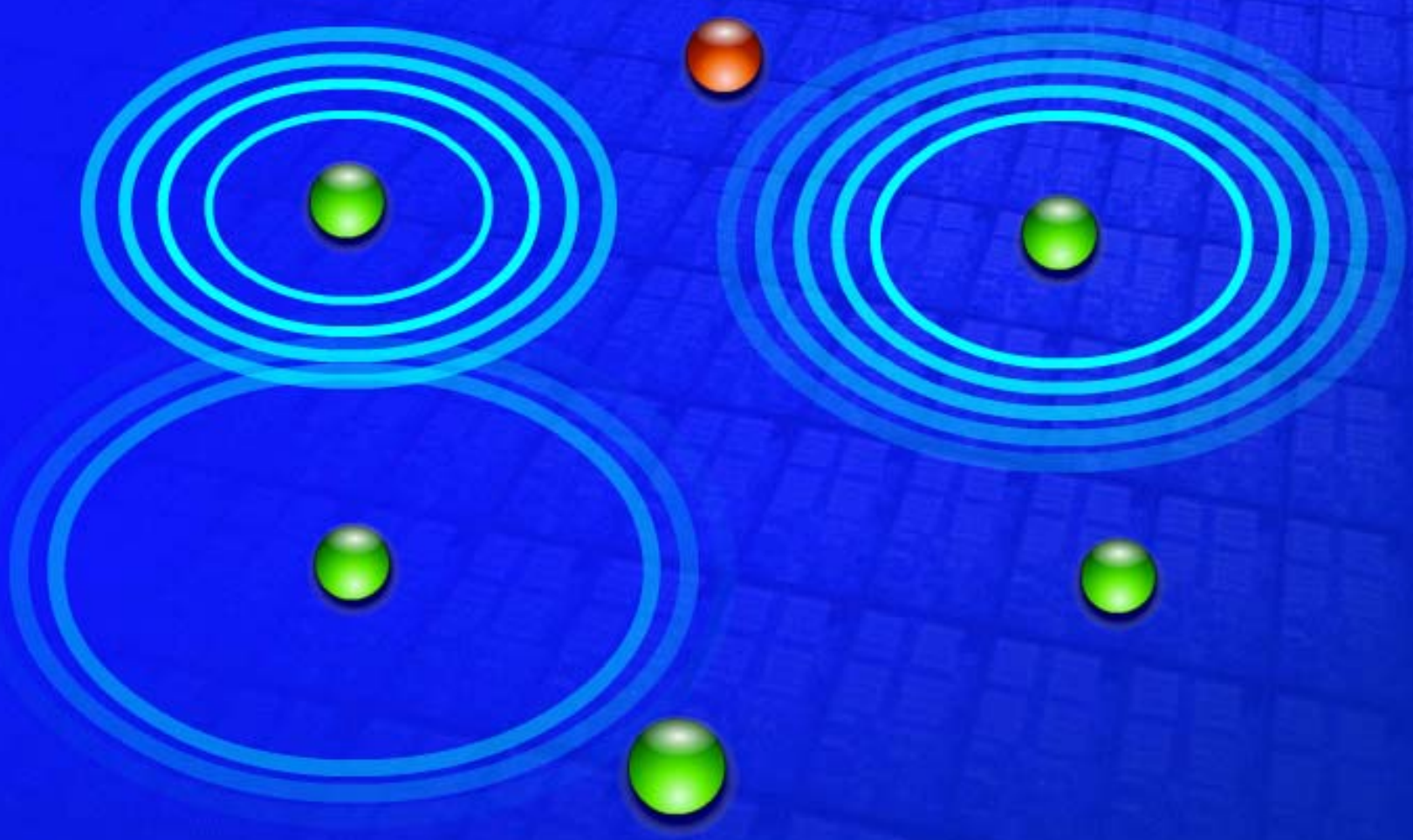
Sleep Mode



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Ad-hoc Sensor Network

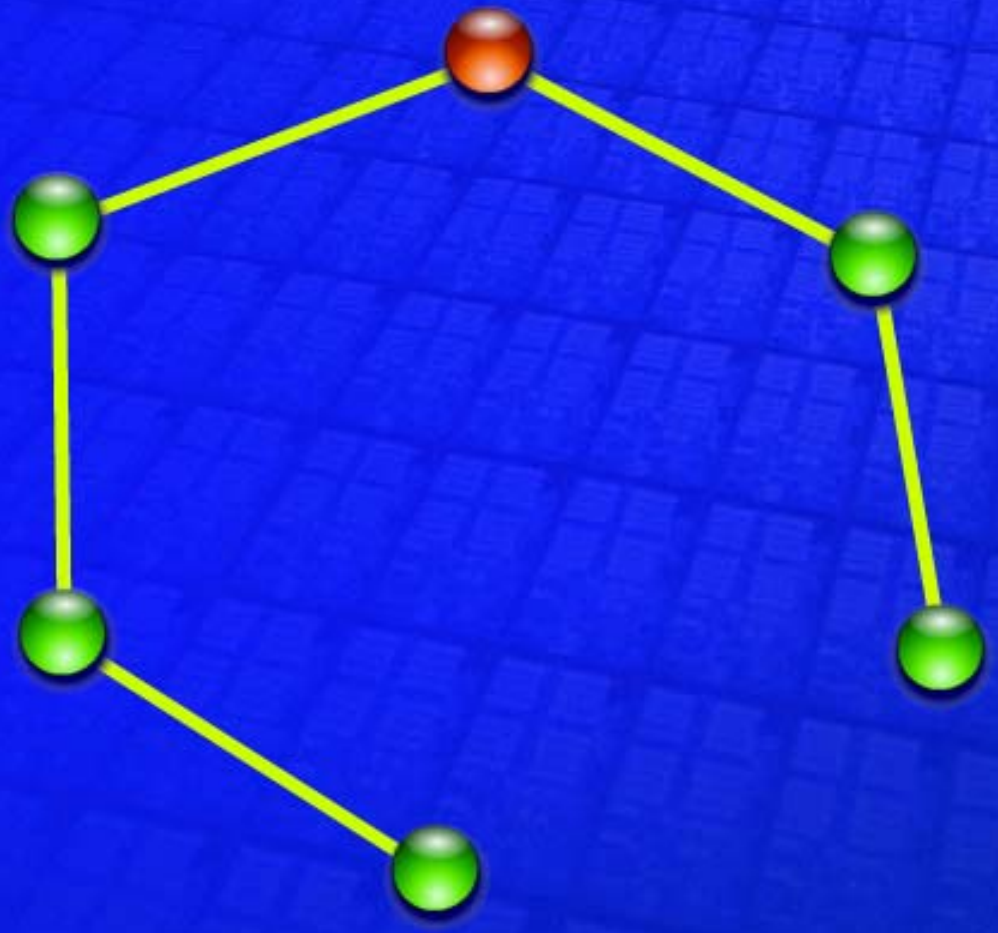
Wake Up Command



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Ad-hoc Sensor Network

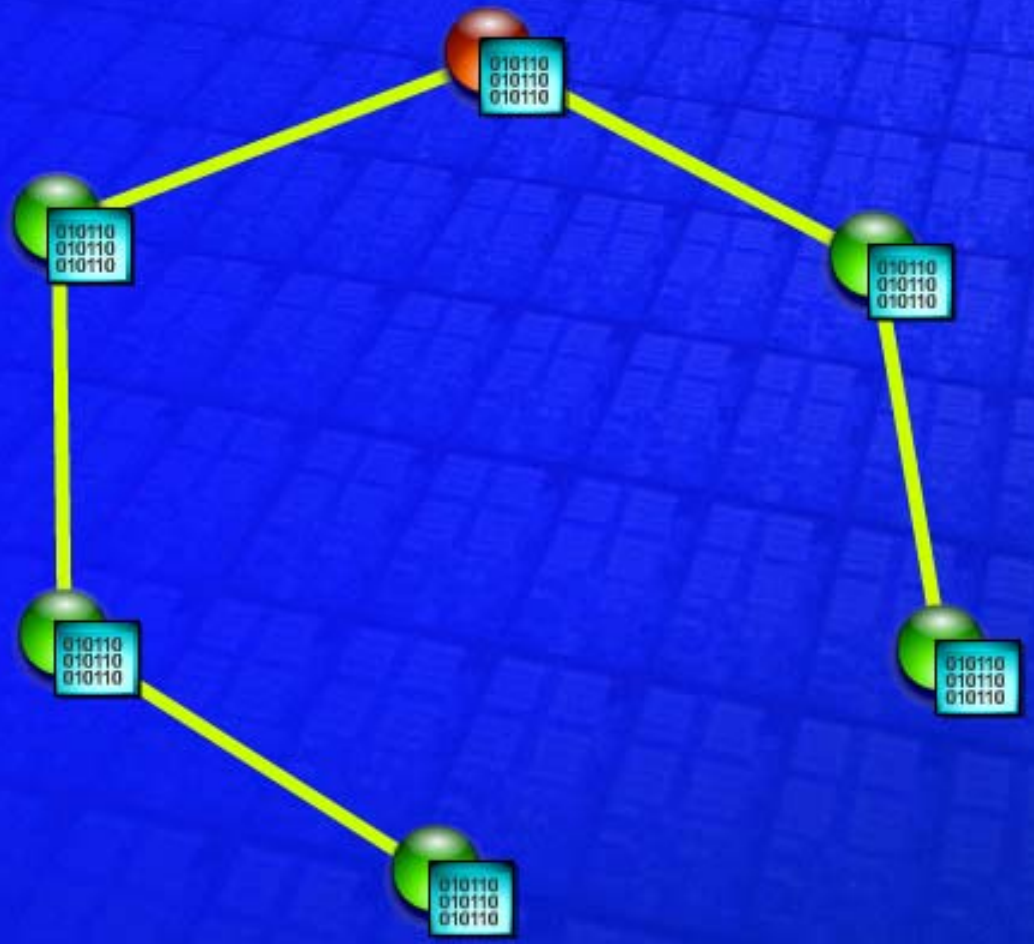
Establish Network Path



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Ad-hoc Sensor Network

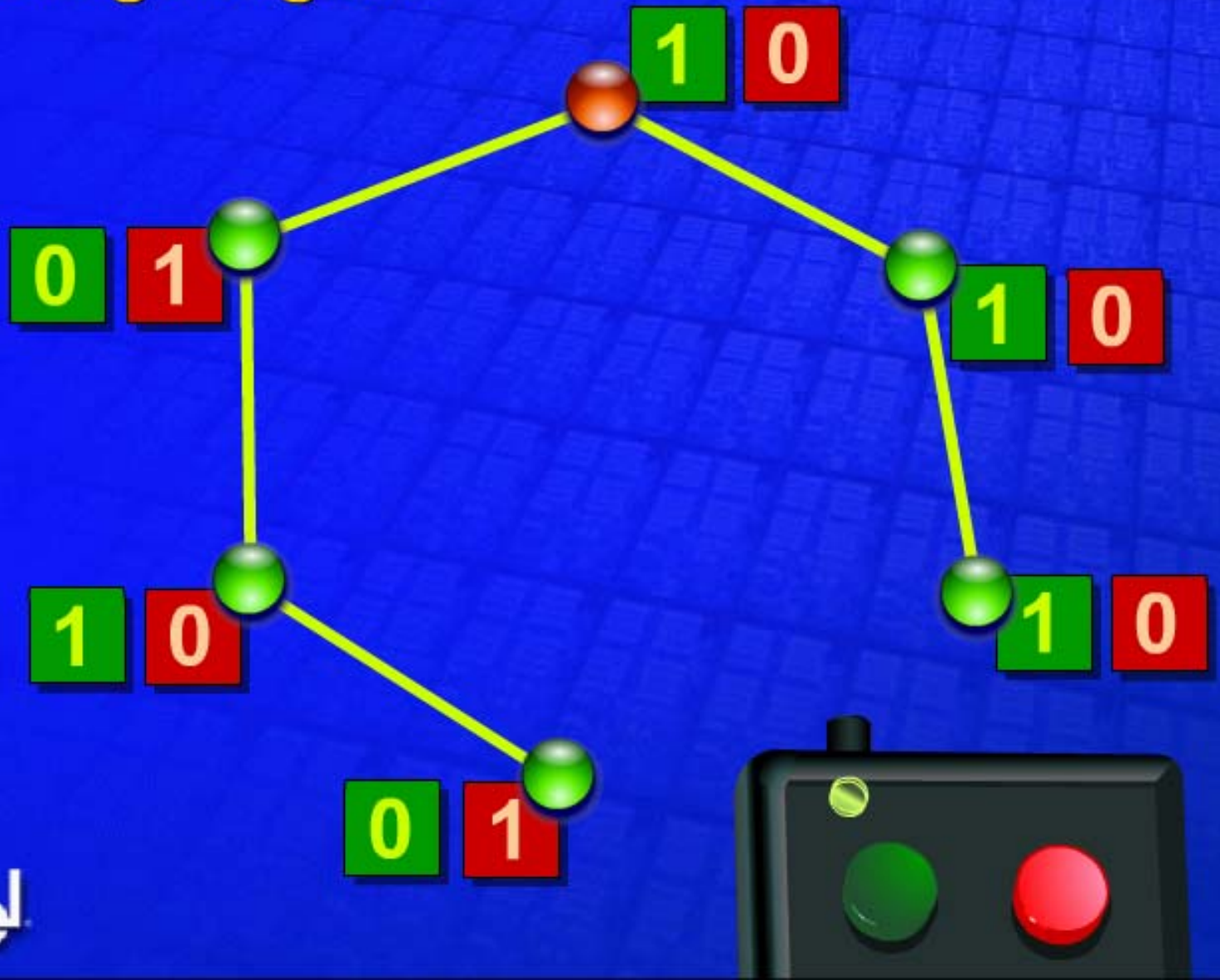
Send Program



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Ad-hoc Sensor Network

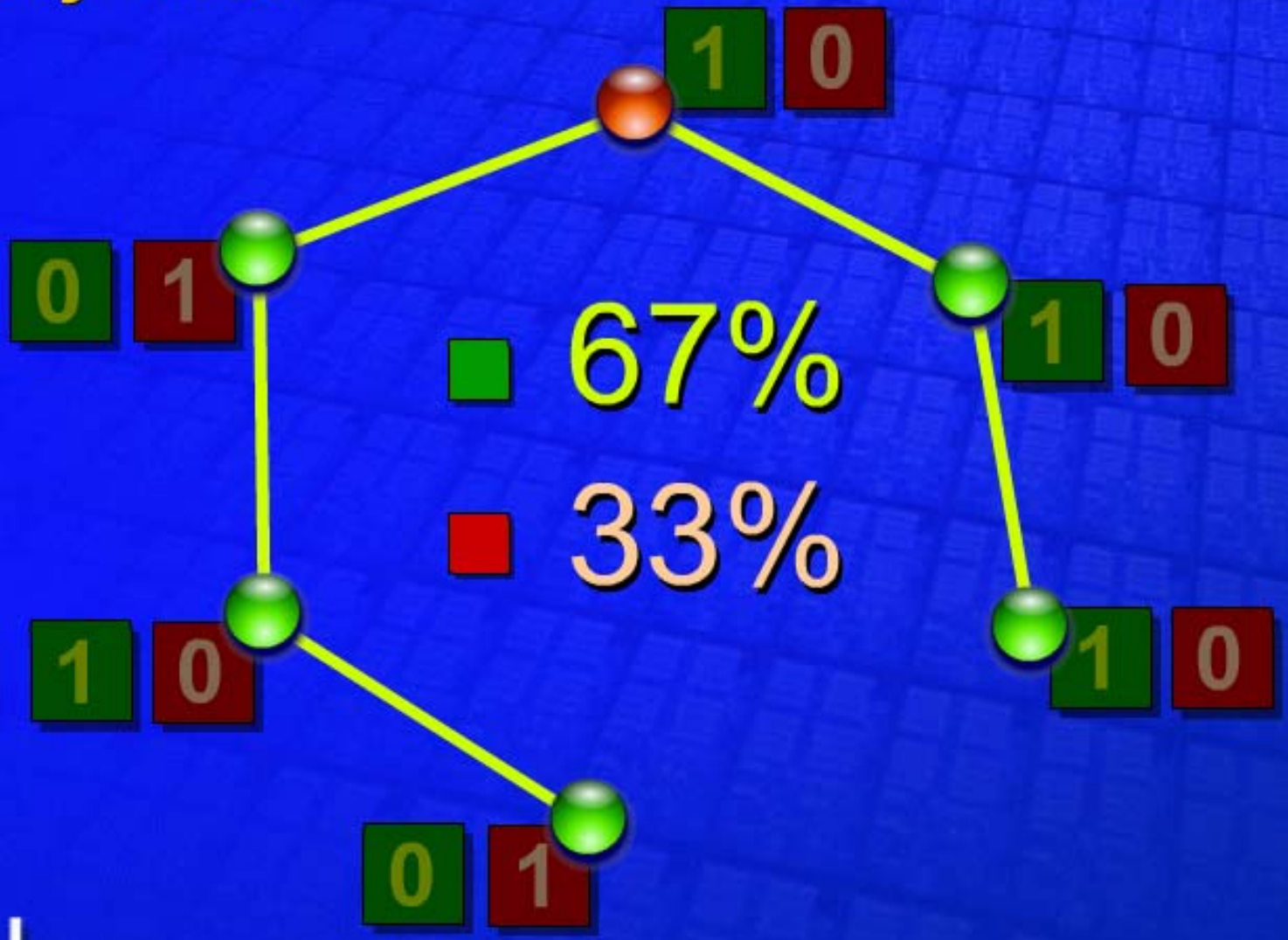
Voting Program



intel

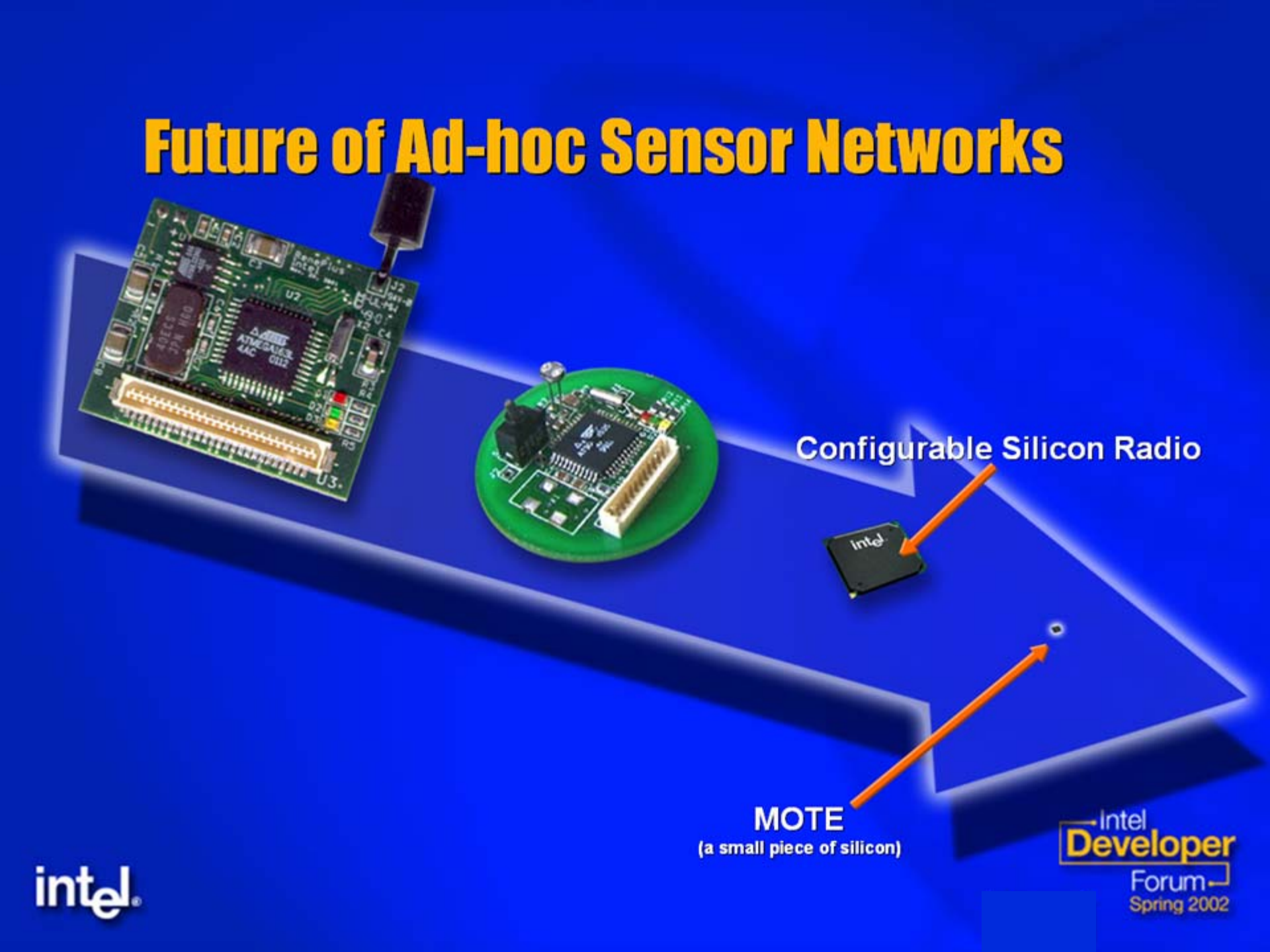
Ad-hoc Sensor Network

Tally Votes



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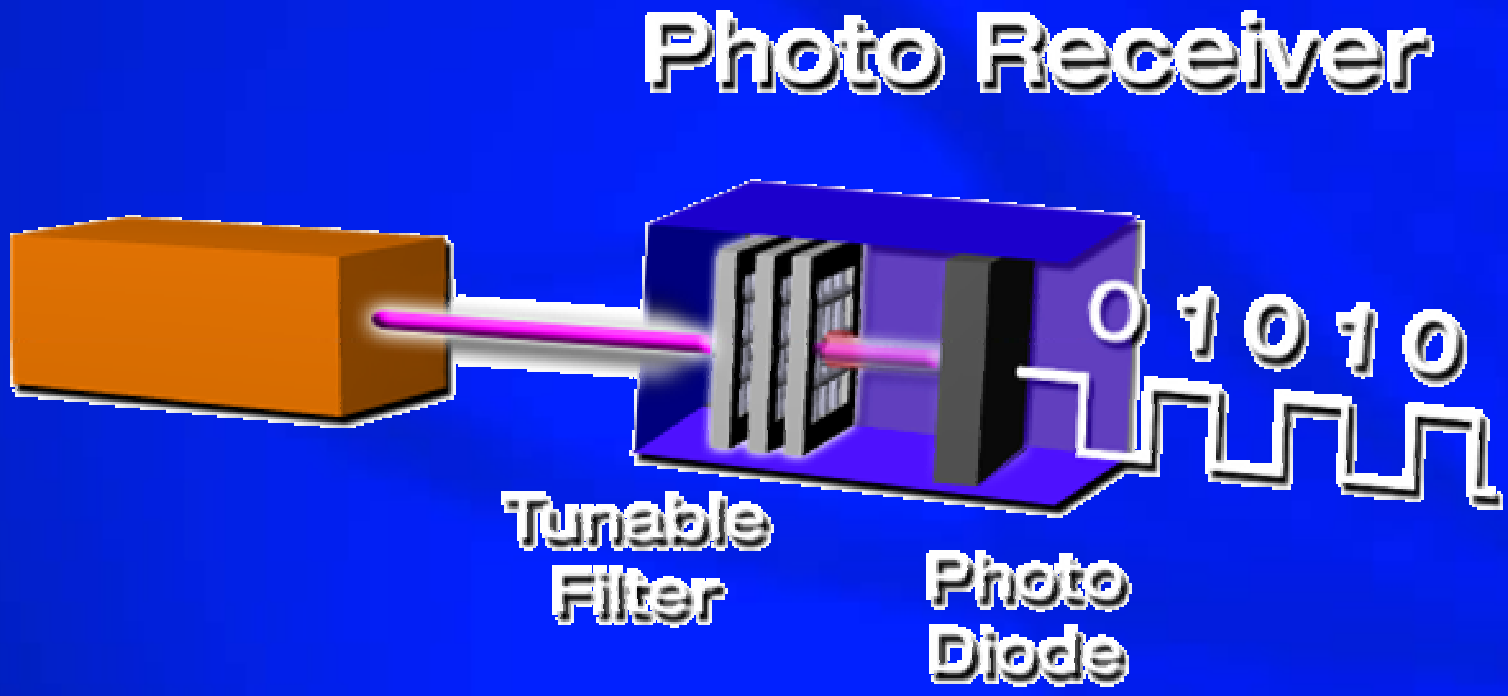
Future of Ad-hoc Sensor Networks



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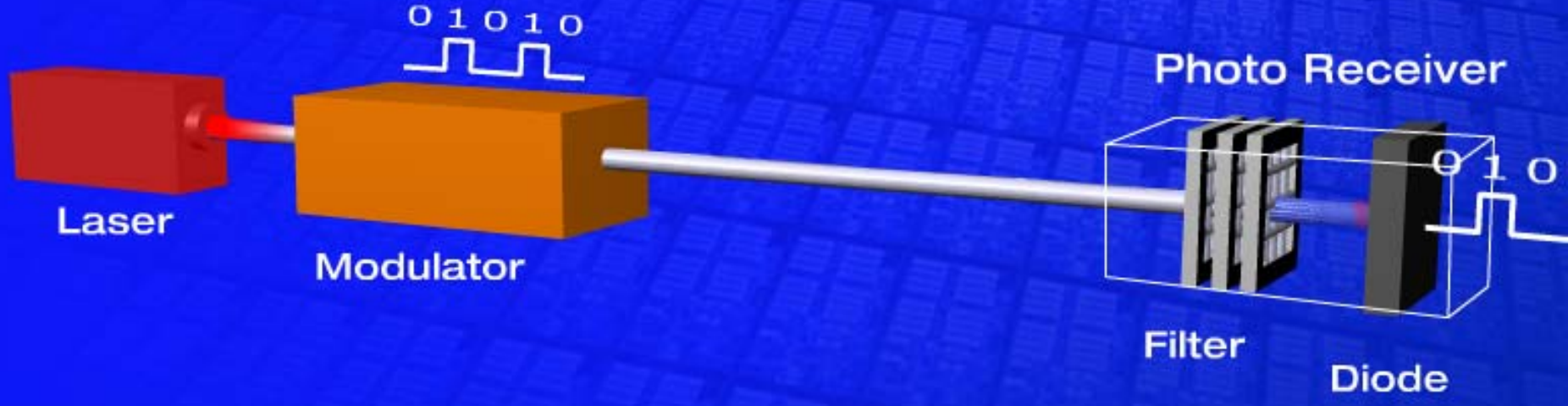
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Can You See the Light?



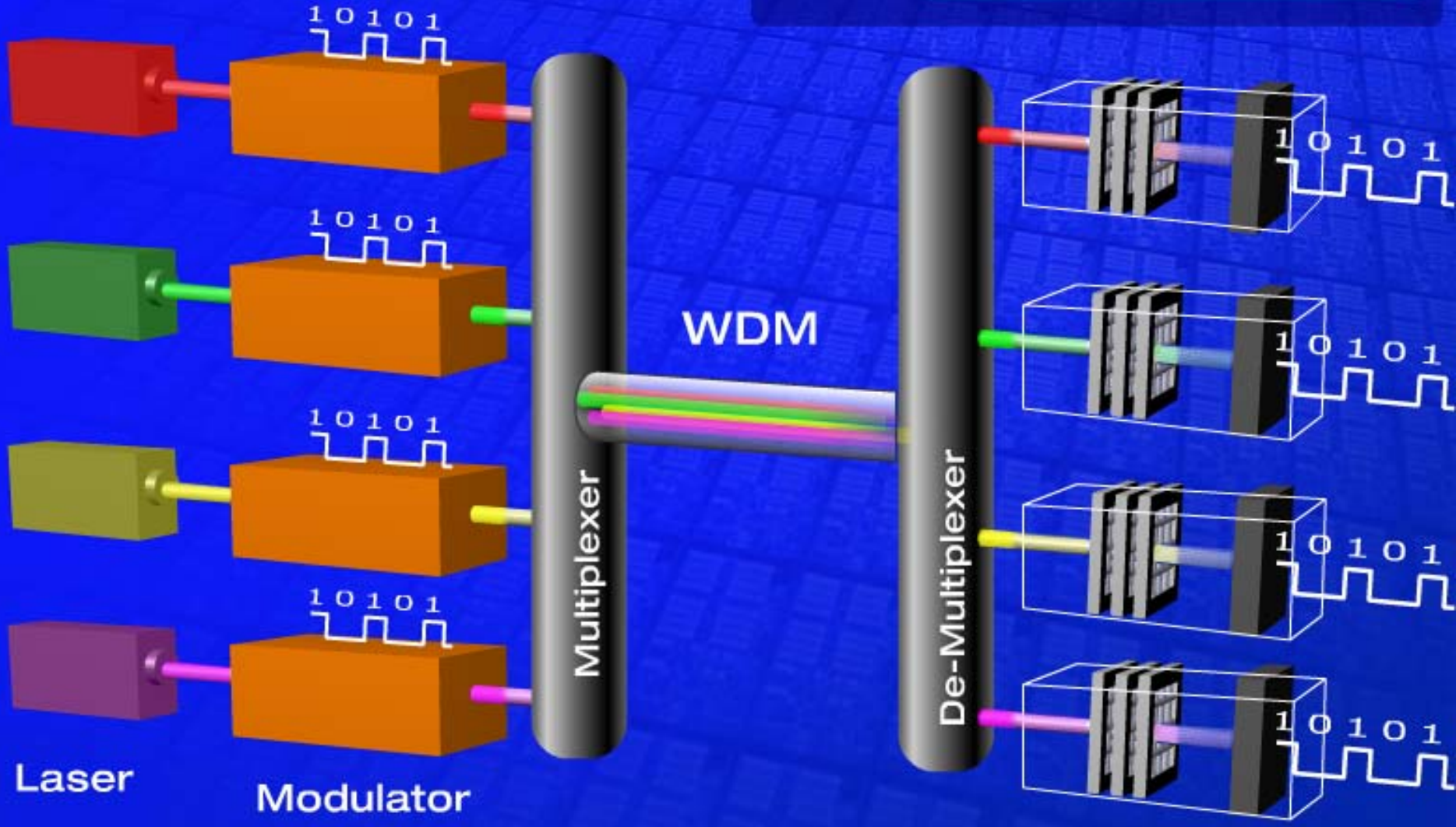
Demo

Optical Communications

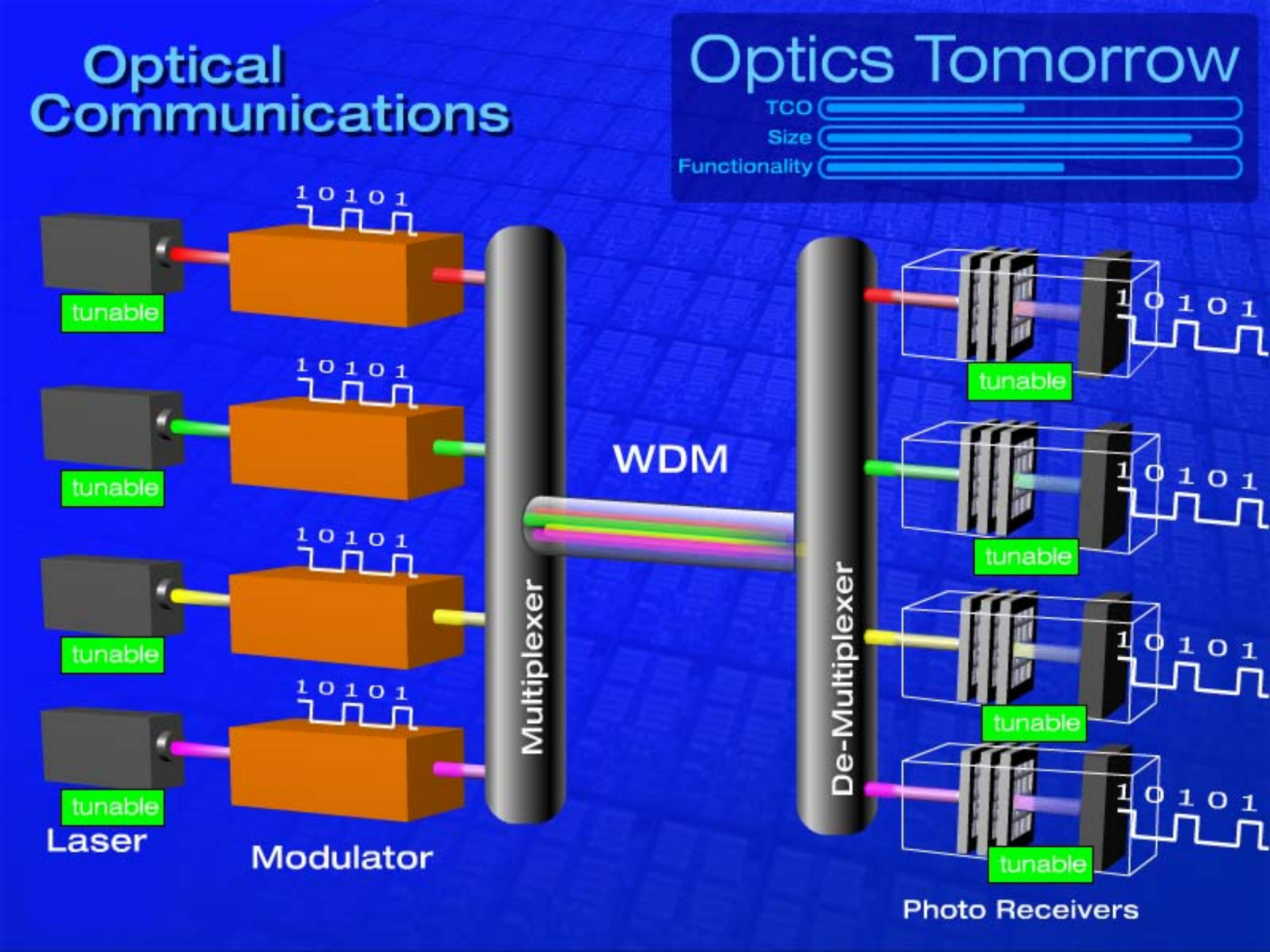


Optical Communications





Optical Communications



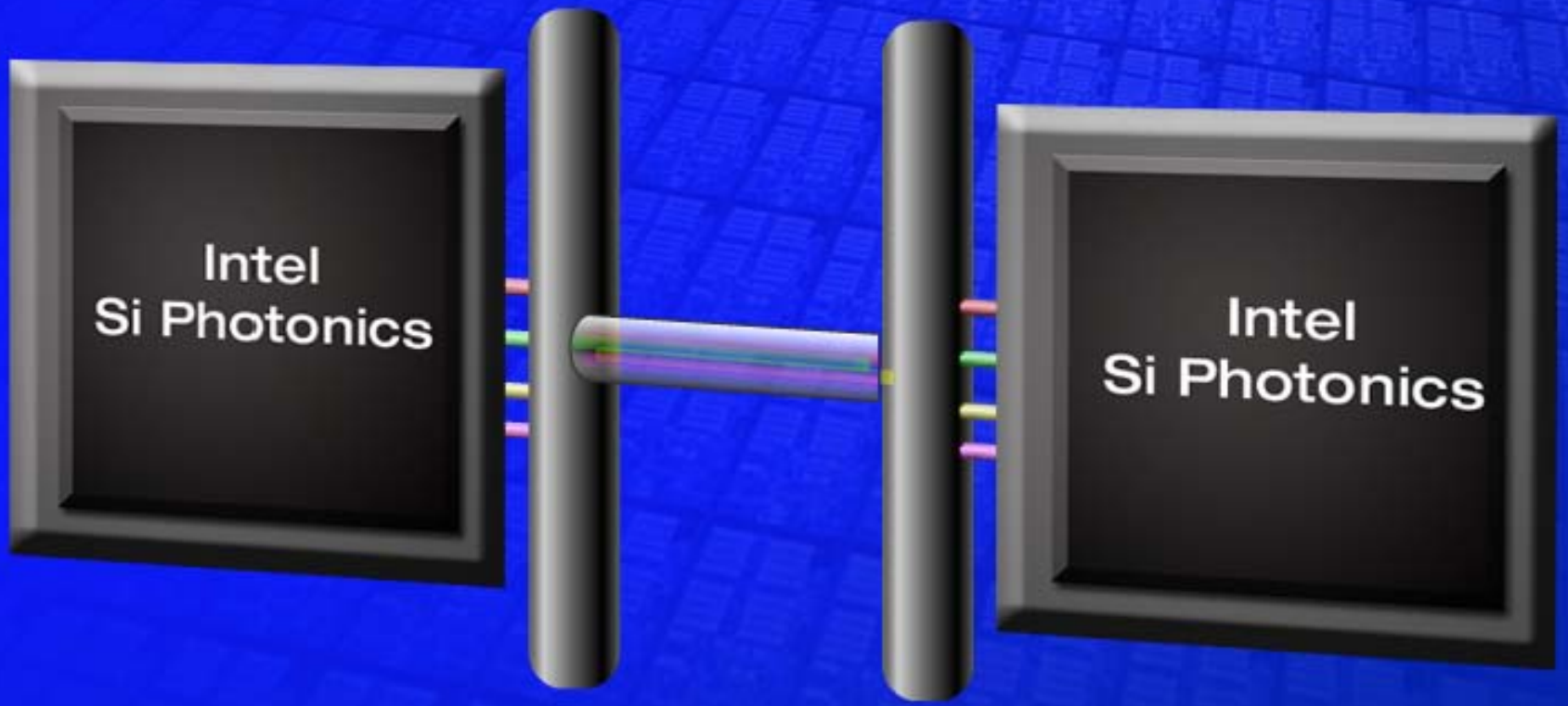
Optical Communications

Optics Future

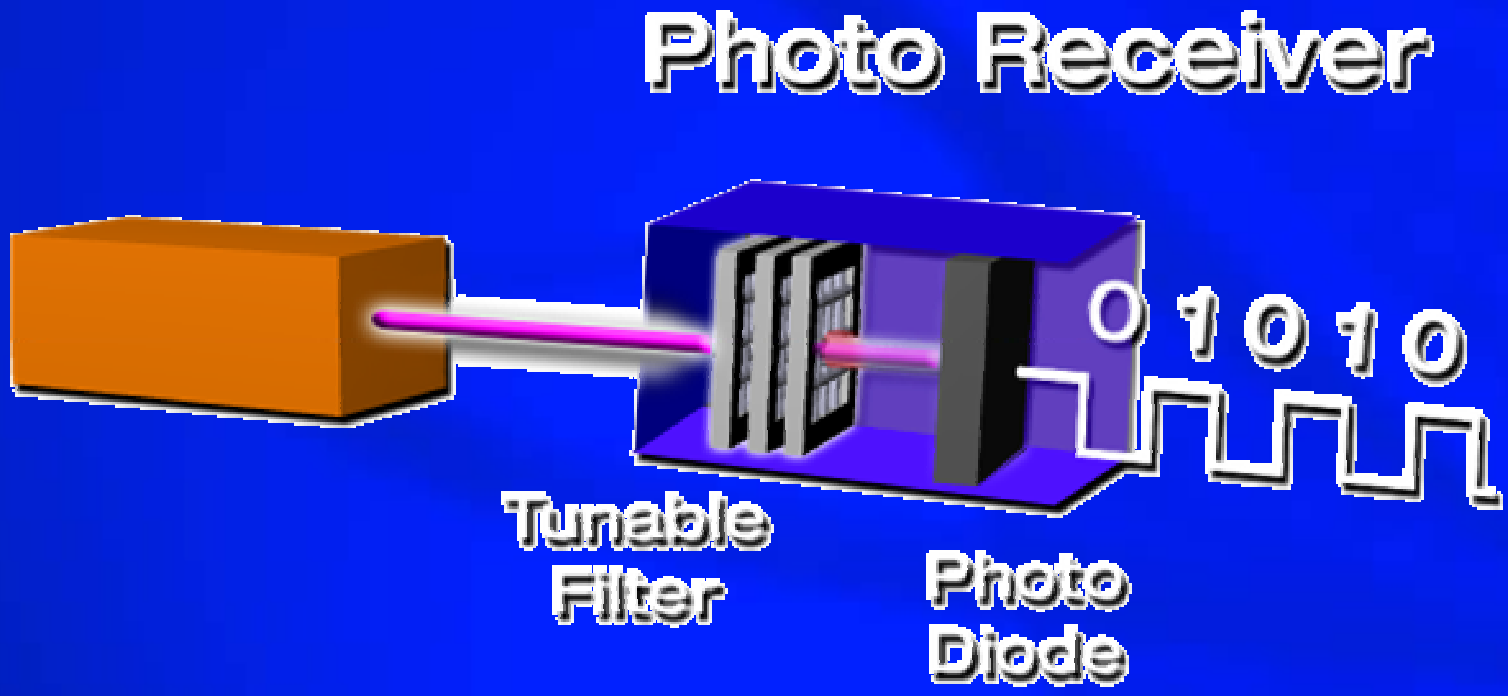
TCO

Size

Functionality



Can You See the Light?



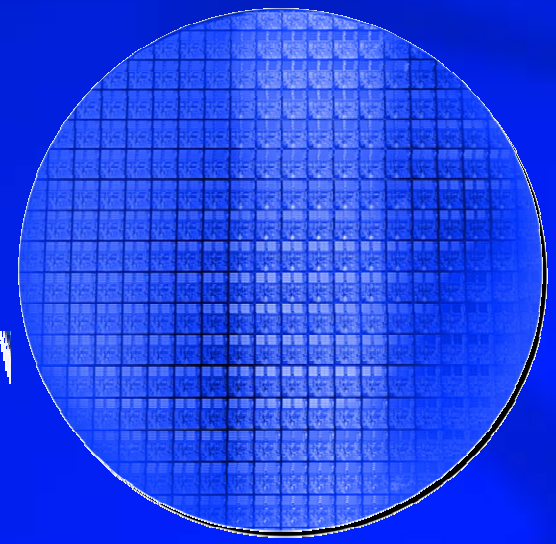
Demo

TODAY

Silicon Electronics

Moore's Law

– Intel Does it Best





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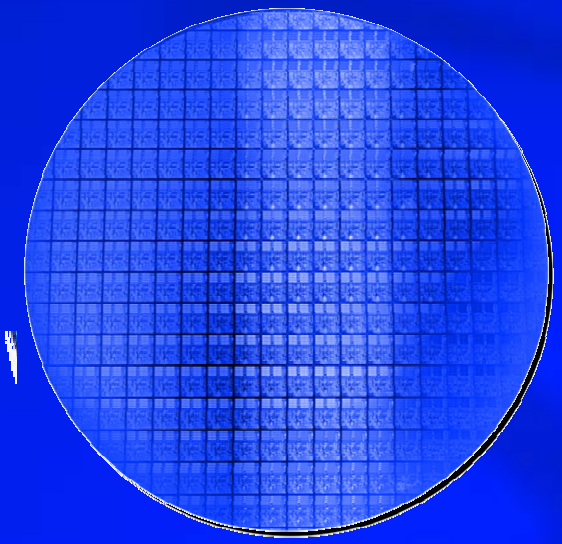
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TODAY

Silicon Electronics

Moore's Law
– Intel Does it Best





RESEARCH

Silicon Photonics

Silicon-based Optical
Building Blocks

- WAVE GUIDES
- FILTER
- MODULATOR
- FAST SWITCH

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Spring 2002

TODAY

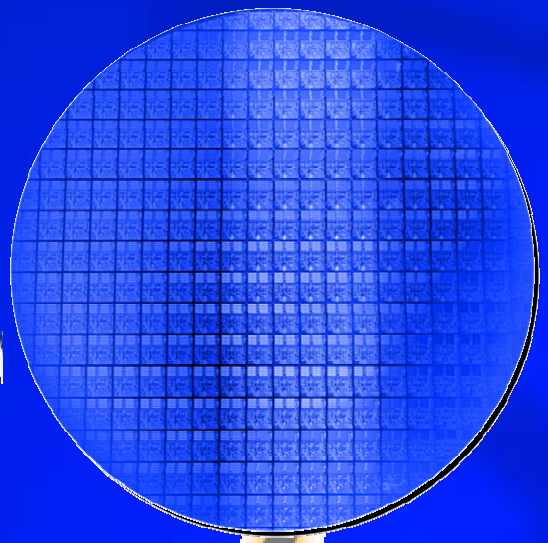
Silicon Electronics

Moore's Law
– Intel Does it Best

RESEARCH

Silicon Photonics

Silicon-based Optical
Building Blocks





WAVE GUIDES

FILTER

MODULATOR

FAST SWITCH



Integrated Electronics and Photonics

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Spring 2002

http://developer.intel.com/update

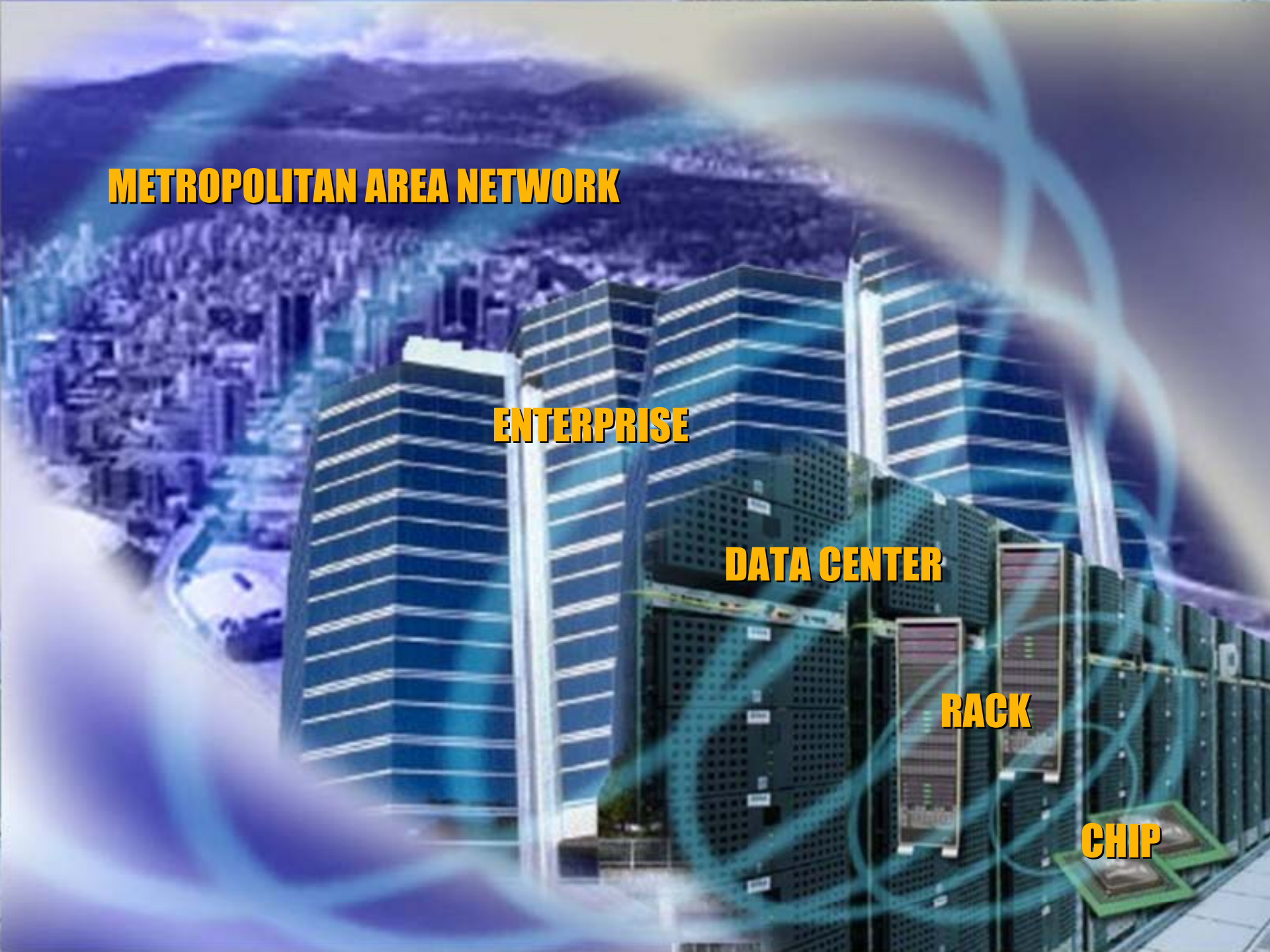
The New Computing and Communications Geography



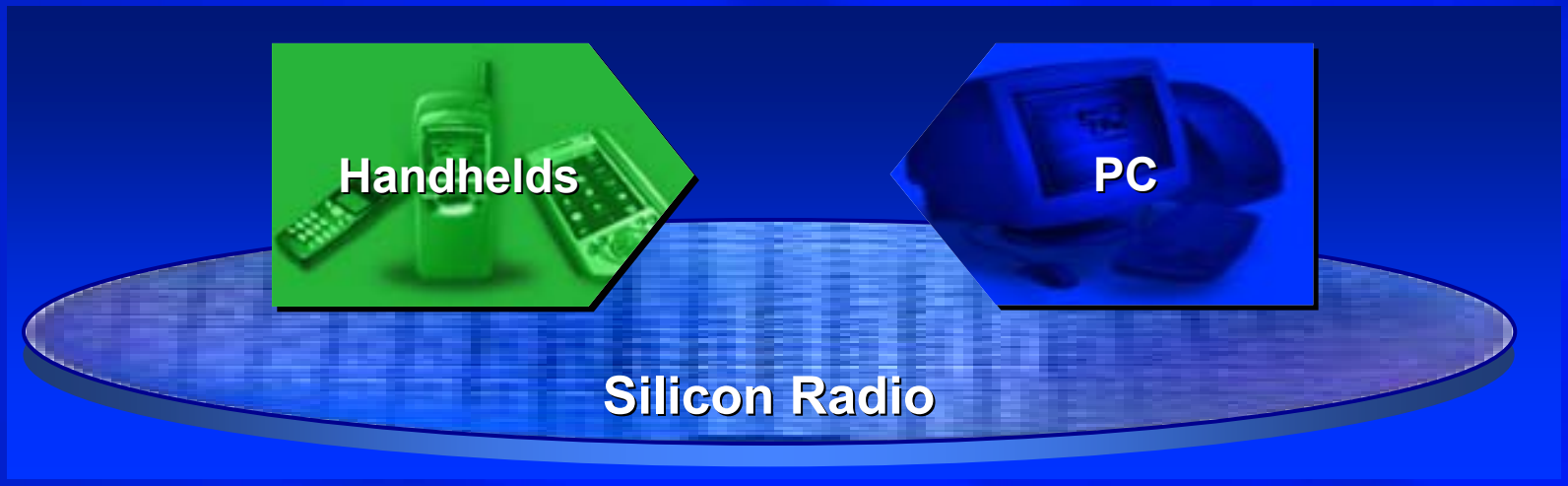


The New Computing and Communications Geography




METROPOLITAN AREA NETWORK
ENTERPRISE
DATA CENTER
RACK
CHIP

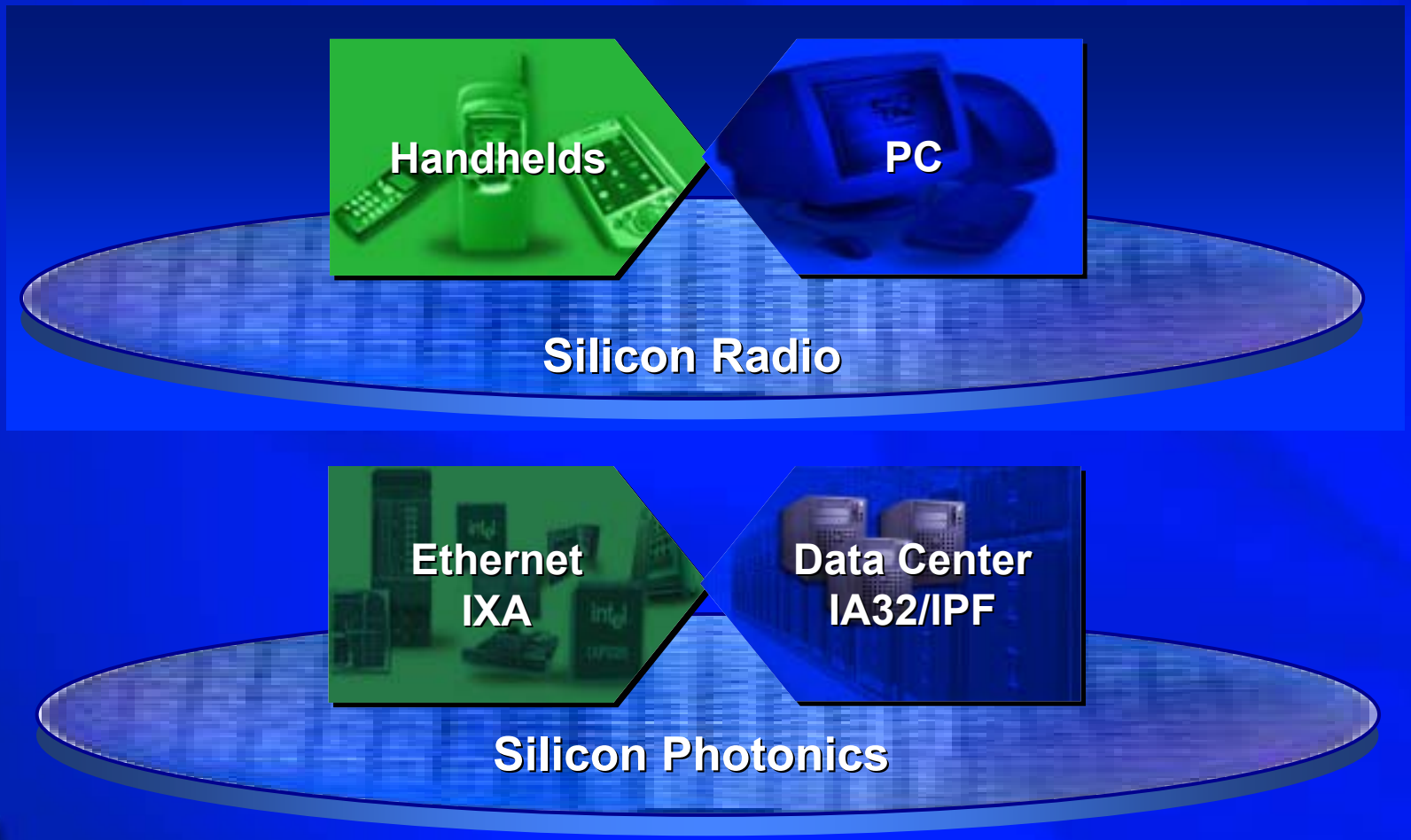
New Computing and Communications Geography





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New Computing and Communications Geography



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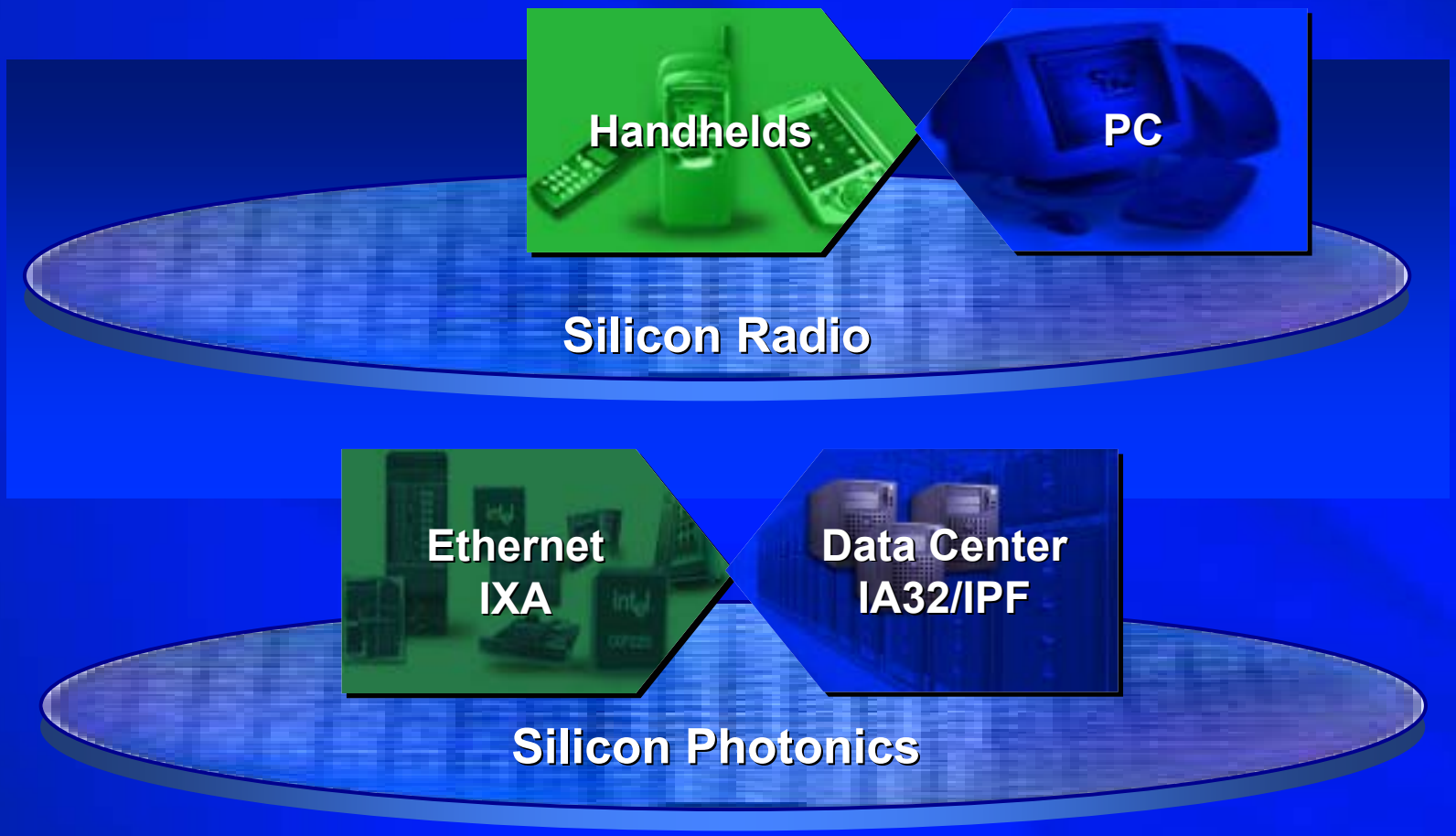
Devices of the Future



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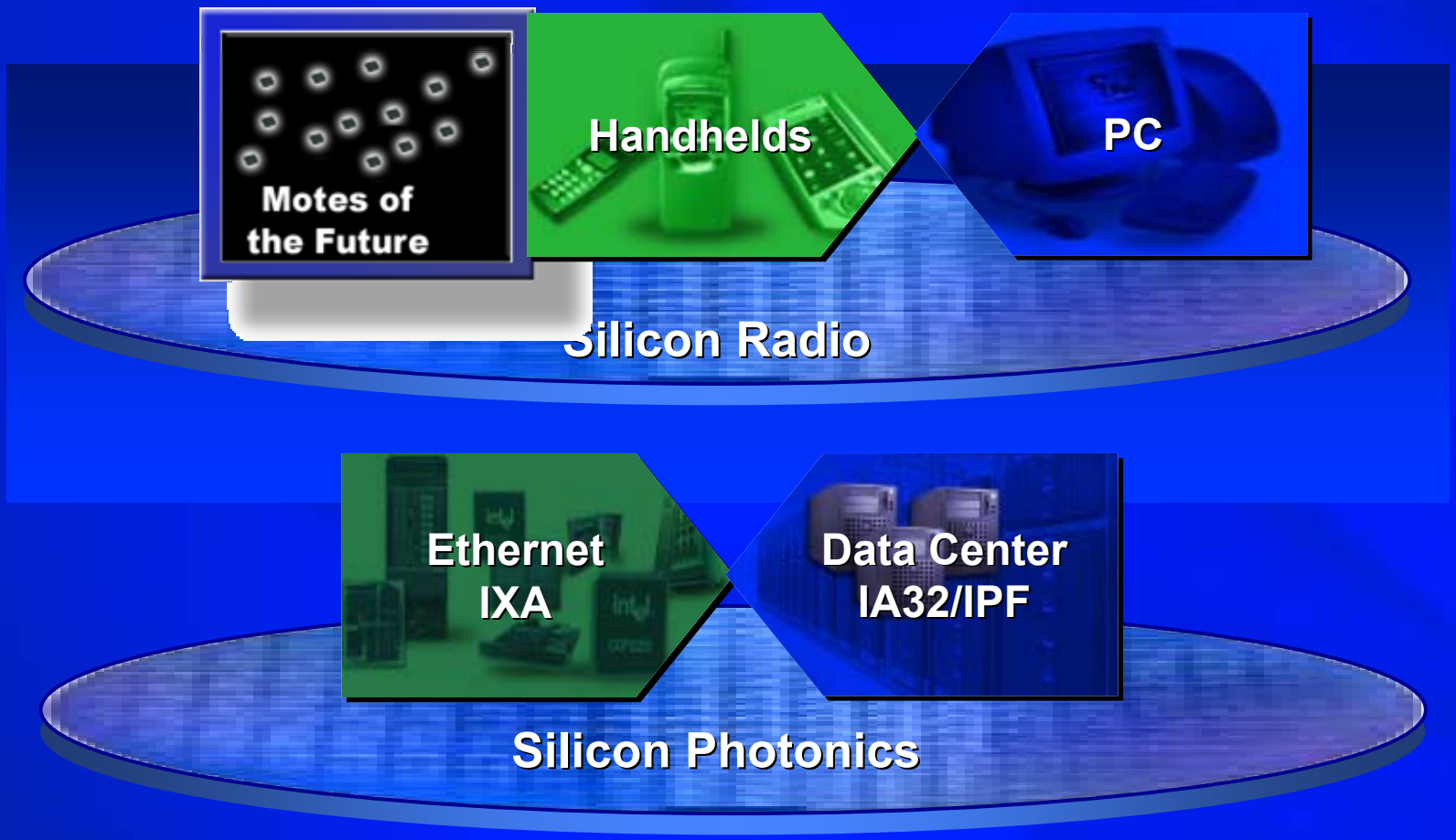
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Spring 2002

New Computing and Communications Geography



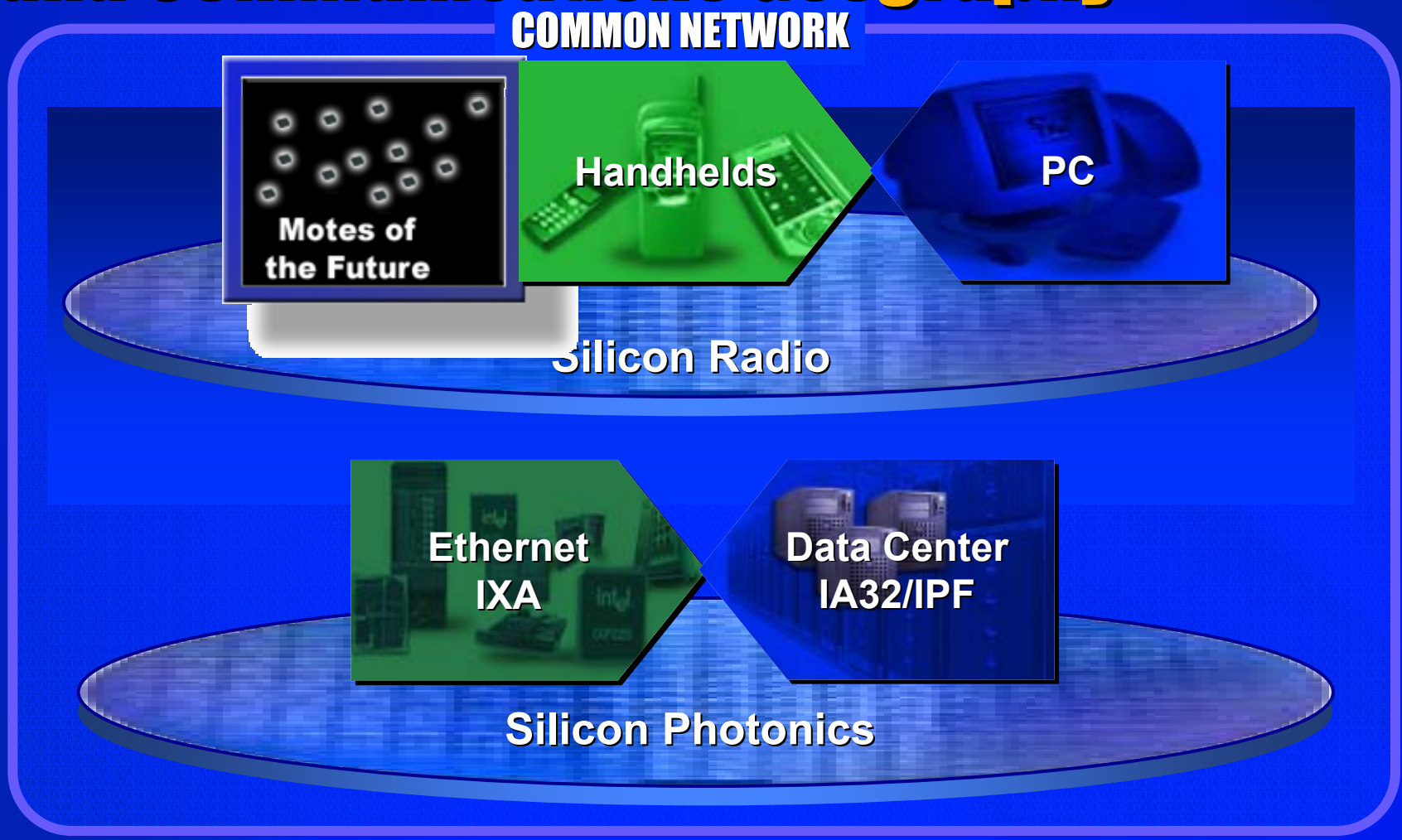
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New Computing and Communications Geography



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New Computing and Communications Geography



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Advancing the Industry Together

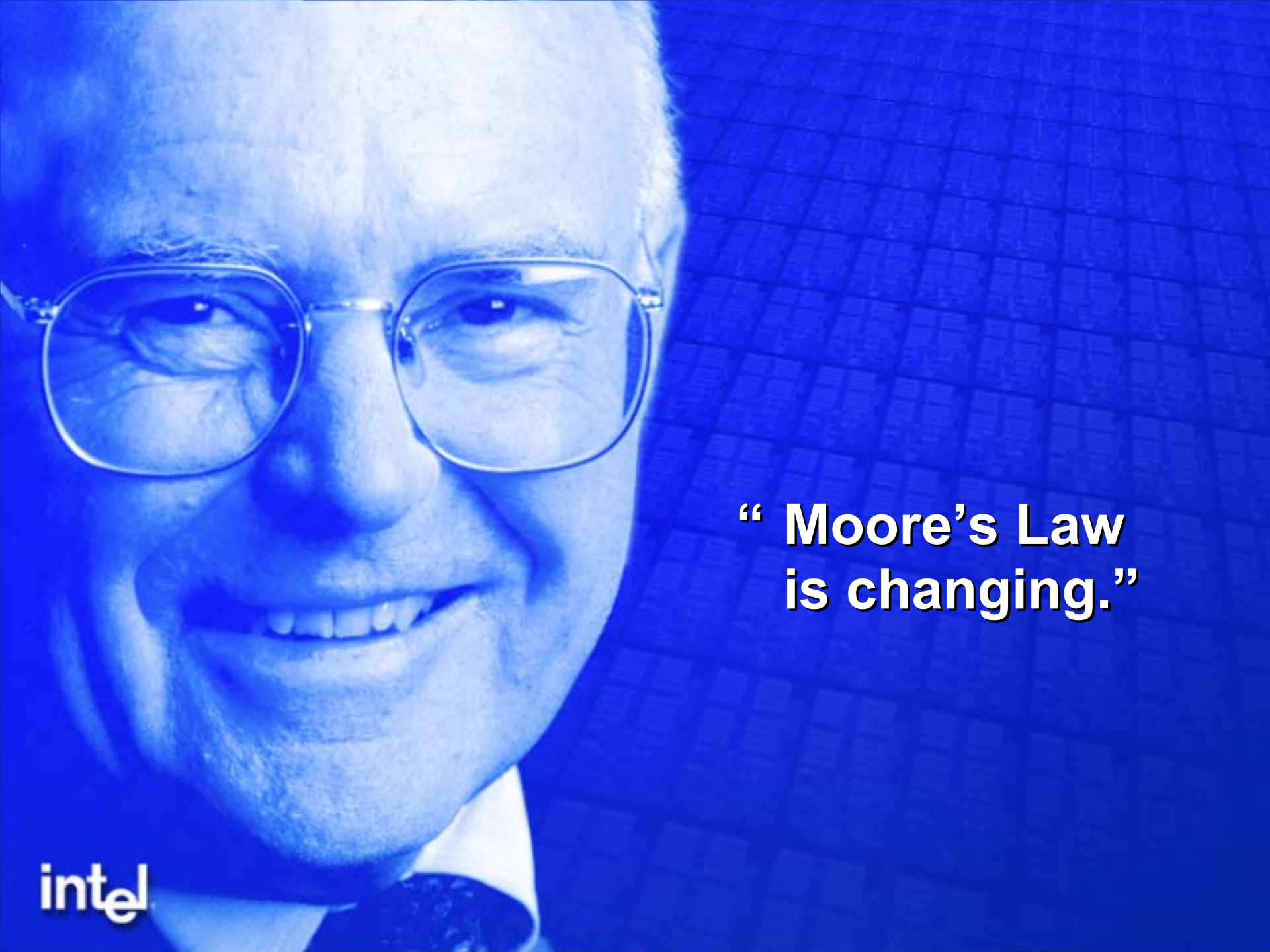
- Intel's obligation

Advancing the Industry Together

- Intel's obligation
- Industry partnership

Advancing the Industry Together

- Intel's obligation
- Industry partnership
- My commitment


“ Moore’s Law
is changing.”
intel

Expanding Moore's Law

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